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FEDERAL SOFTWARE AND RELATED SERVICES MARKET

1987-1992

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Federal Information Systems and Service Program (FISSP)

Federal Software and Relatd Services Market, 1987-1992

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Abstract

INPUT expects the federal government market demand for software and related services to increase from $1.7 billion in fiscal 1987 to $3.0 billion in fiscal 1992. The market will experience sustained growth at an average rate of 12% through the period.

The federal software and related services market consists of two distinct, but interrelated segments: off-the-shelf software packages and their maintenance, and professional services activities required to develop custom software. During this period, software products will exhibit more rapid growth, but the custom software development will account for the majority of federal expenditures in this category.

This report discusses agency buying trends, technical issues influencing the market, and major software initiatives in both defense and civilian agencies. Specific examples of opportunities for vendors are identified by agency.

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Software and Related Services—Vendor

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Introduction

This updated report on Software and Related Services in the federal government was prepared as part of the Federal Information Systems and Services Program (FISSP). *Federal Software and Related Services Market, 1987-1992* focuses specifically on software products and software development. The report builds on the previous INPUT market analyses, with extensive revisions to reflect government fiscal year 1988 agency budgets, opportunities for vendors, and recent vendor financial data.

A Scope

This report covers software and related services programs listed in the OMB/GSA/NBS Five-Year Plan for government fiscal years 1987-1992, related federal agency long-range Automated Data Processing (ADP) plans, and federal agency government fiscal years 1987 and 1988 Information Technology Budgets.

Although the period of interest is government fiscal years 1987-1992, the years outside this window are discussed as necessary to provide a complete picture of the development of agency software strategies.

For the purpose of this study, INPUT defines the software and related services market to include the following products and services:

- Software products are also known as software packages.
  - Exhibit B-2 provides a detailed schematic of the types of products and relationships between products covered in this report.
  - Expenditures for purchase, lease or rental, and maintenance are counted as software products expenditures.
- Software development, sometimes called contract programming or programming and analysis, is a subset of professional services.

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B

Methodology

This report is based on research and analysis of information from several sources:

- INPUT's *Procurement Analysis Reports* (PAR).
- Previous INPUT research conducted prior to 1987.
- Discussions with INPUT's FISSP clients.
- Interviews with federal agency officials.
- Interviews with leading vendors in the federal software and related services market.

The OMB/GSA/NBS Five-Year Plan analysis for the INPUT *Procurement Analysis Reports* was reviewed for software programs to be initiated during the period of interest. The available agency Long-Range ADP Plans for government fiscal years 1986-1991 and government fiscal years 1987-1992 were also researched to identify plans for major software initiatives. Additional market share and competitive trend information was derived from vendor GSA Schedule software sales data.

A Questionnaire (Appendix F) was developed for interviewing software vendor executives. (See Appendix A for respondent profiles.)

C

Report Organization

This report has been organized into six major sections.

- Chapter I - Introduction.
- Chapter II - Executive Overview.
- Chapter III - Market Analysis and Forecast.
- Chapter IV - Agency Requirements and Trends.
- Chapter V - Competitive Trends.
- Chapter VI - Key Opportunities.

Several appendices are provided to aid in report use.

- Appendix A - Interview Profiles.
- Appendix B - Definitions.
- Appendix C - Glossary of Federal Acronyms.
- Appendix D - Policies, Regulations, and Standards.
- Appendix E - Related INPUT Reports.
- Appendix F - Questionnaires.

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Executive Overview

A

Federal Software and Related Services Market Segments

This updated forecast and analysis focuses on several specific types of information technology products and services commercially acquired by the federal government:

- Software products, sometimes called software packages, which include off-the-shelf packages and their maintenance.
- Software development, also called programming and analysis, including the modification of packages and new custom development.

As shown in Exhibit II-1, INPUT has divided the software products market segments into systems or applications software. The forecast for this segment includes expenditures based on purchase, lease, or rental of software products.

The software development market represents a subset of the professional services market, discussed in more detail in a separate Market Analysis Report. This segment includes services such as programming, code conversion, and maintenance of custom-developed systems and applications software.

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EXHIBIT II-1

FEDERAL SOFTWARE AND RELATED SERVICES MARKET STRUCTURE

MEANS OF ACQUISITION • TYPE OF ACQUISITION	TYPE OF SOFTWARE	
	APPLICATIONS	SYSTEMS
Software Products Packages		
• Purchase	X	X
• Lease/Rental	X	X
Maintenance		
• Purchase	X	X
Professional Services		
• Modify Package Purchase	X	X
• Custom Development Purchase	X	X

B

Market Forecast

INPUT estimates that the federal government software and related services market will increase from $1.7 billion in FY 1987 to $3.0 billion in FY 1992 with an average annual growth rate (AAGR) of 12% as shown in Exhibit II-2. This estimate reflects an overall AAGR lower than previously forecasted.

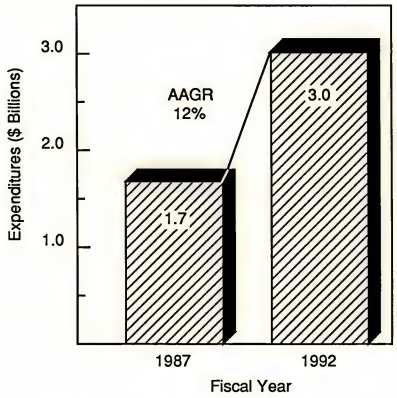
- The depressed growth rate is attributable primarily to slower growth in the software development segment of the market (AAGR = 11%). The expanding functionality of off-the-shelf products coupled with a diminishing perception of unique agency requirements is fueling a "buy, not build" strategy.

- The software products segment exhibits stronger growth (AAGR = 15%) throughout the forecast period, but not strong enough to offset the slowdown in software development. Even this rate, however, represents a reduction from the 17% growth projected one year ago, in INPUT's previous software report.

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EXHIBIT II-2

FEDERAL SOFTWARE AND RELATED SERVICES MARKET, GFY 1987-1992



Note: Expenditures rounded to the nearest $100 million

Currently, software development represents approximately 60% of the software and related services market.

C

Largest Agency Buyers, 1987

Federal agencies fund software and related services acquisitions through portions of several Information Technology Budget categories.

- Capital Investment.
- Operating Costs.
  - Lease/rental.
  - Supplies.

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- Commercial Services.
  - Programming and analysis.

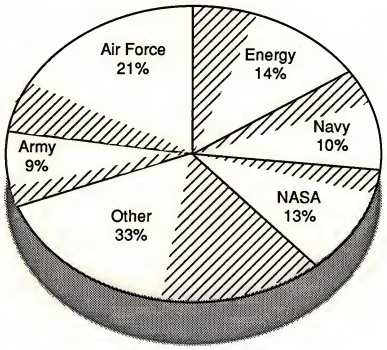
As shown in Exhibit II-3, five agencies—Air Force, Navy, Army, Energy, and NASA—spent 2/3 of the reported software and related services outlays.

- Navy spent more on software products through its BETA-based Qualified Products List and a number of new programs.
- Air Force funded a number of initiatives aimed at increased use of software development.

None of the remaining agencies made up a significant portion of the Information Technology Budget, but acquisition of software products accounted for nearly 35% of outlays.

EXHIBIT II-3

LARGEST AGENCY BUYERS OF SOFTWARE AND RELATED SERVICES, 1987



Total Expenditures = $1.7 Billion

Key:

▨ = Software Products
□ = Software Development

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D

Software Development Vendor Selection Criteria

Exhibit II-4 shows that when evaluating vendors for a software development effort, federal agencies place most importance on relevant experience.

EXHIBIT II-4



- Vendor experience with similar development and integration efforts, the applications to be developed, and the languages to be used outweigh other factors such as price, agency experience, or even federal experience.

- Both civil and defense agencies rank these experience factors as most important. The rankings of other selection criteria differ only slightly between civil and defense agencies.

Education and training capabilities are also closely scrutinized by buying agencies. These agencies seek assurance that not only will the vendor be able to develop the system, but also that the vendor will provide the post-implementation support required to operate and manage the systems via in-house personnel.

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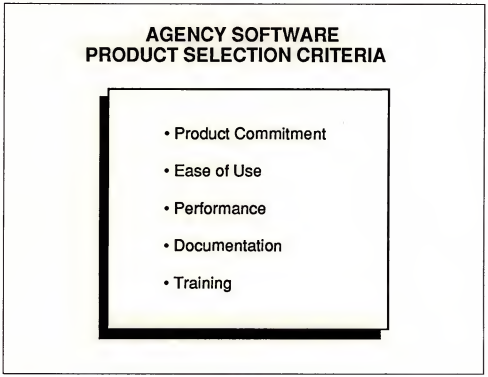
E

Agency Software Product Selection Criteria

Exhibit II-5 reveals that federal agency buyers tend to focus on product characteristics rather than vendor reputation and experience in the selection of software products. Product commitment, ease of use, performance, documentation, and training consistently rank as the most important selection criteria for both systems and applications software products. Product commitment is a special concern for buyers who must plan for relatively long system lives. Products that are not supported and enhanced over time may be viewed as unacceptable risks due to eventual replacement and conversion costs.

On the other hand, documentation and training are important product characteristics in view of the change and variety of users over the expected lifetime of the product. Having priorities that reflect software development selection criteria, agency respondents report that price and federal experience are given less weight in the selection process.

EXHIBIT II-5



F

Leading Software and Related Services Vendors, 1987

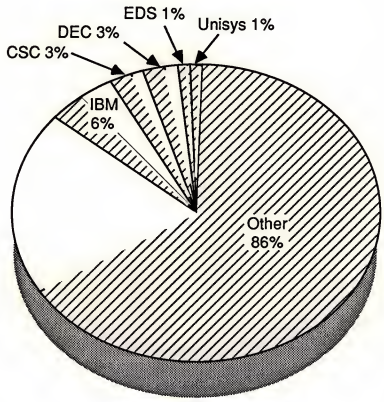
The federal government acquires software and related services from a broad range of vendors including hardware manufacturers, systems houses, professional services firms, and software product developers. Exhibit II-6 shows the leading vendors.

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- Hardware manufacturers and systems houses head the market in terms of revenue.
- Based on INPUT estimates of federal software and related services revenues, four hardware manufacturers (IBM, Unisys, Honeywell, and DEC) and two systems houses/integrators (CSC and EDS) are the leading vendors.

EXHIBIT II-6

LEADING SOFTWARE AND RELATED SERVICES VENDORS, 1987



Total User Expenditures, 1987 = $1.7 Billion

Key:

= Software Products

=Software Development

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Independent software products suppliers that have done well in this market include Oracle, Cincom, Computer Associates, Software AG, and UCCEL. The success of these vendors is based, in part, on combined buys that include hardware and software. This buying patterrn is particularly true in systems software when the conventional wisdom is that hardware systems buys (as opposed to hardware-plus-software buys) from a single vendor offer greater assurance of operability.

G

Competitive Outlook

The competitive outlook is illustrated in Exhibit II-7. During the forecast period, INPUT expects that the hardware manufacturers and systems houses will retain their current dominant market presence. Market share, however, will likely change due to the continuing trend toward system integration contracting by federal agencies.

- As a group, systems houses are in the best position to take advantage of this trend and could increase market share substantially by providing integrated hardware, software, and development solutions.
- Hardware and software product vendors may find fewer direct product sales opportunities, but increased opportunities to place their products through the systems houses. Only IBM, among the hardware manufacturers, seems well positioned to gain from growth in systems integration services.

Despite rapid overall expansion in the software products market segment, individual vendors may not experience corresponding revenue growth. Heavy discounting, in many cases up to 50% off commercial pricing, and site-licensing pressures will moderate revenue growth.

EXHIBIT II-7



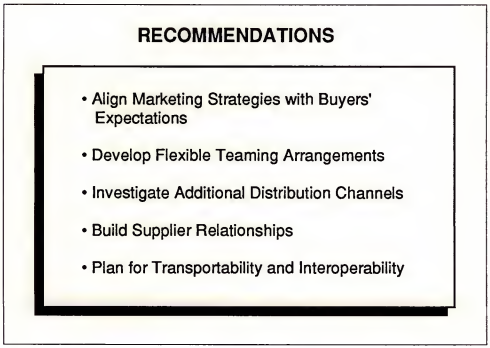
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H

Recommendations

In bidding software to the federal government, vendors may need to adjust their marketing and product development strategies to align more clearly with buyers' expectations. One key issue is product commitment, where agencies seek concrete assurance that the product acquired today will be supported and enhanced over the years to come. Exhibit II-8 summarizes INPUT recommendations.

EXHIBIT II-8



Software product vendors should also investigate alternative distribution channels, such as systems houses, to supplement direct sales. Revenue from one large-scale, multisite integration contract can easily exceed total annual direct sales from single-product copies. These software vendors should increase their teaming relationships with professional services firms experienced in federal bidding.

Systems houses can gain a competitive advantage in pricing by building and maintaining long-term relationships with software product suppliers. Reduced development efforts through the use of packaged software modules and lower unit prices accompanying volume purchase agreements both act to hold down costs and improve margins. Vendors can expand their market shares by planning products and services to meet agency requirements for transportability and interoperability across different hardware suites and operating systems. Agencies continue expressing concern over integration of applications in an extremely diverse hardware environment. In some cases, agency customers may prove to be helpful in interagency marketing efforts.

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Market Analysis and Forecast

A

Market Structure

In general, federal agencies acquire the software they use in one of the following ways:

- Purchase with the hardware suite in turnkey systems buys or system integration programs.
- Purchase "off-the-shelf" packages from the software vendor, either as a standalone purchase or as part of a hardware purchase.
- Purchase custom development of software that represents a new software product (generally referred to as "programming and analysis" and classified by INPUT as "software development" under the professional services mode).
- Purchase custom modifications of software already in use by the agency (generally referred to as "software maintenance").

Only those software products that are purchased, modified, or developed by outside vendors, and therefore represent existing market opportunities, are considered in this report, except for software productivity improvement measures where, in INPUT's view, the agencies' internal activities could be supported or replaced by vendors' products/services.

B

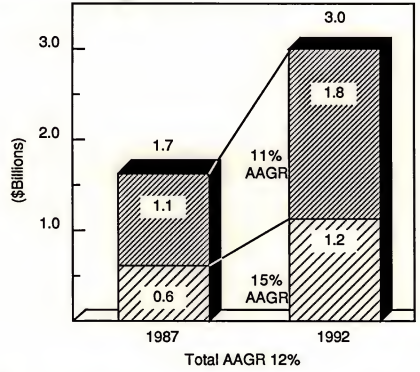
Market Forecast

Of the $12.7 billion in contracted information technology support listed in the estimated government fiscal year 1987 budget, INPUT forecasts that $1.7 billion will be expended for software and related services. By 1992, these expenditures will have grown to $3.0 billion for an average annual growth rate (AAGR) of 12%, as shown in Exhibit III-1.

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EXHIBIT III-1

FEDERAL SOFTWARE DEVELOPMENT AND SOFTWARE PRODUCTS MARKET, GFY 1987-1992



Note: Numbers rounded to the nearest $100 million Updated 12/87

- Approximately 65% of the 1987 expenditures will be for contract programming and analysis, also called custom software development. The remaining amount ($0.6 billion) will be expended on "off-the-shelf" software products.
- About 15% of the software products expenditures will provide for vendor maintenance. The proportion of custom software outlays related to maintenance is unknown.
- GSA and NBS have estimated that at least one-third of internal software costs apply to maintenance.

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1. Mode Forecast

The expenditure growth rate for software products will exceed that for software development through the forecast period. Agency budget constraints are forcing more packaged software acquisition, at the expense of custom software development. Vendors are more frequently including in their products those functions that have previously forced agencies to seek custom solutions. At the same time, agencies, under funding pressure that forces them to justify the cost effectiveness of the software solution approach, are "perceiving" fewer unique requirements. The net result of these two events is a greater attractiveness of off-the-shelf software.

Some 90% of the government's software is custom-developed, but then some "watchdog" agencies believe the lengthy, expensive process is not justified when much of the software is not fundamentally different from commonly available products.

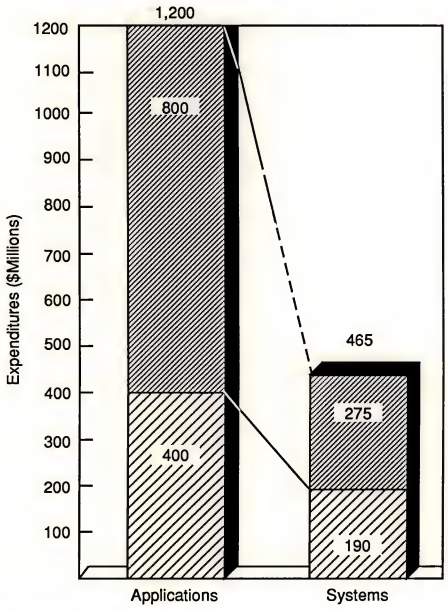
This faster growth rate of software product expenditures will not offset the much-slower rate of software development growth due to the substantially larger size of the latter.

Expenditures for applications software represent about 2/3 of the forecast for 1987, as shown in Exhibit III-2. Both packaged and custom software display this 2/3:1/3 distribution of expenditures.

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EXHIBIT III-2

APPLICATIONS VERSUS SYSTEMS SOFTWARE BY TYPE OF ACQUISITION, 1987



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- The Exhibit is only a representative portrayal of systems software acquisition. An unreported amount of this software is included by the hardware vendor with the hardware purchase.

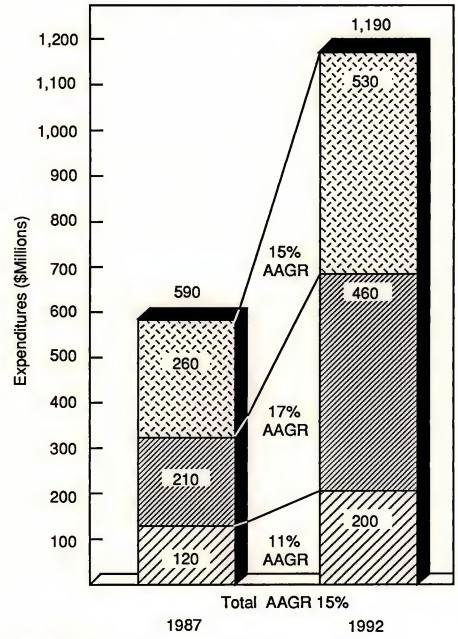
- Custom systems software development is not typically a target objective in itself. Rather, the systems software effort is a necessary prerequisite within a larger application orientation.

- Although much of the government is under a "buy not lease" mandate, the reality in software products is that lease acquisitions will continue to show stronger growth, as shown in Exhibit III-3. By 1992, more acquisitions will be made via purchase than by lease. This data reflects Lease-to-Ownership Plans (LTOP) now required in the federal supply schedule.

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EXHIBIT III-3

METHOD OF SOFTWARE PRODUCTS ACQUISITION, 1987-1992



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2. Agency Forecast

Defense agency software budgets are shown in Exhibit III-4. Agency government fiscal years 1986-1988 budget requests for line items that include INPUT's "software and related services" categories are similar for defense and civil organizations.

- Systems analysis and programming budget requests, which include the custom software development expenditures of this report, have increased at an average annual growth rate of 7% for defense agencies and 8% for civilian agencies.

EXHIBIT III-4

DEFENSE AGENCIES' SOFTWARE BUDGET
GFY 1986-1988

	$ MILLIONS			AAGR 1986-1988 (Percent)
	1986	1987	1988	
Systems Analysis and Programming	781	898	939	7
Software (Capital Investment)	105	168	131	8
Total	886	1,066	1,070	7

Updated 12/87

- On the other hand, civilian agencies are showing, percentage-wise, a significantly larger increase in software capital investments. In fact, the 18% growth rate for civilian agencies (versus 8% for defense) has enabled them to overtake defense in budgeted dollars.

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EXHIBIT III-5

CIVIL AGENCIES' SOFTWARE BUDGET
GFY 1986-1988

	$ MILLIONS			AAGR 1986-1988 (Percent)
	1986	1987	1988	
Systems Analysis and Programming	939	1,175	1,169	8
Software (Capital Investment)	95	134	148	18
Total	1,034	1,309	1,317	9

Updated 12/87

- Packaged software expenditures are included in budget requests under capital investment for software, lease/rental of software and "other" supplies, and operation and maintenance (for the software maintenance portion). The budget items presented in Exhibit III-5 (capital investment for software) are not inclusive of all packaged software acquisitions but do indicate the the direction and magnitude of agencies' software expenditures. As noted, this budget category has increased substantially over the three-year period.

Specific agency budget changes are presented in Exhibits III-6a and III-6b for software analysis and programming and Exhibits III-7a and III-7b for capital investment for software.

- Among defense agencies, the Air Force, Navy, and Army all have substantial systems analysis and programming budgets. But, as mentioned above, growth in expenditures over the last three years has been slow and will remain so for the forecast period. Slow growth not withstanding, these agencies represent significant opportunities for custom software development , with over $900 million in planned spending in government fiscal year 1988 alone.

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EXHIBIT III-6a

SYSTEMS ANALYSIS AND PROGRAMMING BUDGET BY DEFENSE AGENCY GFY 1986-1988

DEFENSE AGENCIES	$ MILLIONS			AAGR 1986-1988 (Percent)
	1986	1987	1988	
Air Force	417	428	449	3
Army	111	178	220	32
Navy	201	215	211	2
USMC	18	21	7	(20)
OSD	34	56	52	17
Total Defense	781	898	939	7

Updated 12/87

- Systems analysis and programming budgets for civil agencies are considered smaller than those in defense except for NASA, Energy, GSA, and HHS. Of these four, only the latter two have shown consistent growth over the market average. Opportunities for custom software development will be more limited outside of the agencies mentioned.

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EXHIBIT III-6b

SYSTEMS ANALYSIS AND PROGRAMMING BUDGET BY CIVIL AGENCY, GFY 1986-1988

CIVIL AGENCIES	$ MILLIONS			AAGR 1986-1988 (Percent)
	1986	1987	1988	
Agriculture	19	34	25	11
Commerce	10	12	11	3
Energy	211	299	244	5
Education	5	4	5	0
Environmental Protection	8	16	18	42
GSA	153	193	203	11
HHS	145	168	185	9
HUD	14	18	17	7
Interior	14	14	22	19
Justice	8	10	12	16
Labor	11	9	22	33
NASA	240	263	274	5
State	12	10	14	6
Transportation	41	51	50	7
Treasury	22	24	29	11
Veterans	3	23	15	133
Other Civil	23	27	23	-
Total Civil	939	1,175	1,169	8
Total Federal	1,720	2,075	2,108	8

Updated 12/87

- The requested funding for software products under the capital investment category is largest at the Army and Navy. Much of the growth occurred in government fiscal year 1986 and is unlikely to pick up during the forecast period.

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EXHIBIT III-7a

SOFTWARE (CAPITAL INVESTMENT) BUDGET BY DEFENSE AGENCY, GFY 1986-1988

DEFENSE AGENCIES	$ MILLIONS			AAGR 1986-1988 (PERCENT)
	1986	1987	1988	
Air Force	2	3	2	0
Army	41	89	47	5
Navy	48	49	54	4
USMC	3	5	2	(11)
OSD	11	22	26	45
Total Defense	105	168	131	8

Updated 12/87

- Civil agencies have more propensity for packaged software purchases and represent better vendor targets. Commerce is the largest buyer with $24 million requested in 1988, up an average of 81% since 1986. Other large target agencies include NASA, HHS, Treasury, and Transportation.

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EXHIBIT III-7b

SOFTWARE (CAPITAL INVESTMENT) BUDGET BY CIVIL AGENCY, GFY 1986-1988

CIVIL AGENCIES	$ MILLIONS			AAGR 1986-1988 (Percent)
	1986	1987	1988	
Agriculture	16	13	12	(8)
Commerce	7	11	24	81
Energy	2	2	1	(16)
Education	(Less than 1 million)			0
Environmental Protection	1	3	3	67
GSA	(Less than 1 million)		1	0
HHS	9	25	15	22
HUD	(Less than 1 million)			0
Interior	6	11	13	39
Justice	3	6	5	22
Labor	1	2	1	0
NASA	13	17	19	15
State	4	4	4	0
Transportation	4	9	20	133
Treasury	16	12	17	2
Veterans	2	4	3	16
Other Civil	11	15	10	(3)
Total Civil	95	134	148	18
Total Federal	200	302	279	13

Updated 12/87

Exhibit III-8 sheds additional light on agencies' specific initiatives for software and related services through the forecast period. (Also see Chapter VI for specific key opportunities.)

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EXHIBIT III-8

MAJOR SOFTWARE PRODUCTS AND RELATED SERVICES PROGRAMS BY AGENCY

	NUMBER OF PROGRAMS	TOTAL FISCAL YEAR 1987-1992 ($M)
DEFENSE AGENCIES		
Air Force	14	376.6
Army	7	450.4
Navy	5	352.7
DLA	1	25.3
Office of the Secretary	1	409.6
USMC	1	8.9
Total	29	1,623.5
CIVILIAN AGENCIES		
Agriculture	2	7.2
Commerce	1	143.2
Interior	2	89.4
Justice	3	19.4
Transportation	2	100.8
Treasury	5	1,910.9
GSA	2	408.1
NASA	3	108.2
AID	1	45.9
SEC	1	2.6
Total	22	2,835.7

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C

Federal Market Issues

1. Regulations and Policies

As noted earlier, there is continuing pressure on agencies to contain costs by maintaining existing software and, when that is not possible, to acquire software packages rather than create new custom software. General Accounting Office (GAO) studies have assessed the experience of agencies over the last several years and have identified these problems:

- Agencies spend considerable amounts of programming time and funds on outside contracts to maintain software, but the maintenance process is frequently undermanaged. Lack of uniform definitions and control of costs are but two of the problems frequently cited.

- The General Accounting Office has noted insufficient testing of software during development and installation. The establishment and compliance monitoring of testing policies as well as the more frequent use of automated tools and testing techniques would, in the General Accounting Office's opinion, reduce the more expensive procedure of correcting errors after the software is in operation.

- Related to the above, the General Accounting Office has reported dramatic cost and schedule overruns in software development. Frequent problems include premature contracting before agencies fully understand what they need, missing or inappropriate performance criteria, inadequate management of the development process that result in missed agency-vendor communications, and failure to inspect contractors' work at intermediate stages.

As a result of these and other deficiencies, software acquisition procedures are expected to undergo transition in the coming years.

- The Army prepared new software support contracting standards (DoD-STD-14676-AR) for DoD-wide application.

- Navy Data Acquisition Command (NAVDAC) instituted benchmark procedures for software packages that will be specified in future ADPE acquisitions.

- Defense Acquisition Council to the Federal Acquisition Regulations presented changes to the FAR concerning the government's technical data and software rights when the government contracts for the development. Subsequent rejections by OMB led to a softened position in early 1987.

- GSA instituted more stringent vendor financial and maintenance requirements for software offered in GSA computer stores and on FSS schedules.

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- GSA Request For Quotes for the GFY 1988 Software Federal Supply Schedules 70A and 70C encourage purchase. The 70C contracts for microcomputer software prohibit lease, whereas the 70A contracts allow lease when it is typical in the commercial area. GSA Contracting Office also seeks perpetual licenses whenever possible.

- A proposed change to FIRMR will allow each agency to select an acceptance criterion that is appropriate to the economic and performance risk of specific applications.

- Changes in both the Federal Supply Schedules and the Federal Acquisition Regulations in 1986 require vendors to offer packaged software at a lowest "best client" discounted price or to demonstrate the commerciality of the product to support catalogue prices.

OMB A-130, "Management of Federal Information Resources," established the policy of choice for software packages over custom development and encouraged use of nonprocedural languages and modern software engineering techniques to improve maintainability. This policy has been extended throughout agency software acquisitions.

DoD noted in its fiscal year 1986 budget hearing before Congress its intentions regarding software acquisition, evaluation, and use for programming aids:

- Use integrated and automated software tools and programming aids.

- Reuse, where possible, previously acquired software packages.

- Transfer, as soon as practical, the software development technology from the Software Institute to both in-house and contractor practices.

In responding to recent Congressional calls for better ADP planning, DoD will clarify its intentions on these issues. These methods are being initiated at federal agencies:

- The Bureau of Reclamations personnel and payroll system is used by the Department of Energy and Education.

- ACTION contracted for the modification of an existing accounting system, saving 75% of the development cost and time to build a new system.

- Many agencies use software available from the National Association of State Information Systems.

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2. Software Integration

Software is the interface medium between machines, applications, and end users. Agencies need strategies and vendor support to implement these integrations.

- Agency respondents noted a growing need for portable software that is readily adaptable to a changing hardware environment. As new hardware technologies are put in place, the next generation of software must accommodate change and communications between incompatible equipment.

- Similarly, agencies are increasingly required to merge large applications into a single, transparent software system that, as one respondent put it, fits the end user's needs rather than the end user adapting his need to the capabilities of the software. Nowhere is this demand more urgent than in the PC-based and PC-to-mainframe applications where simple, easy-to-use interfaces are more the exception than the rule.

3. Productivity Improvement

To modernize software and effect productivity improvement, agency ADP organizations are seeking greater use of:

- Software engineering technologies, including more-efficient software management methods, software development methodologies, and data dictionaries.

- Higher-level development tools, including program generators and fourth-generation languages.

- Better analytic tools for all sizes of machines—microcomputers, minicomputers, and mainframes—that will provide programmers with development aids such as automatic documentation, cross-referencing, etc. Agencies also required improved system software for supercomputers.

One approach, data administration, provides techniques and software tools to arrange large amounts of data. By organizing, indexing, and cross-referencing data according to the business requirements of the organization, agencies are better equipped to plan procedures for the comprehensive development of future systems. Specifications from the American National Standards Institute (ANSI) are now being reviewed by agencies and vendors. Although a standard data dictionary software specification is some years away, vendors, especially of Data Base Management Systems (DBMSs), need to be cognizant of the pending impact of this trend.

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Fourth-generation languages (4GLs) are being employed by agencies to increase productivity in software development and maintenance. Currently, 4GLs are used primarily for end-user computing and reports, along with some decision support. Other applications for 4GLs are being designed and will eventually ease the burden on agency staff and computer resources.

The Programmer WorkBench (PWB) concept has been sponsored by the GSA's Federal Software Management Support Center. To date, two BETA tests have been established (SSA and DLA), the products have been selected, and contracts are in place for agencies to purchase these products from GSA. If successful, the program will be expanded to include not only the entire IBM software management suite, but also non-IBM environments.

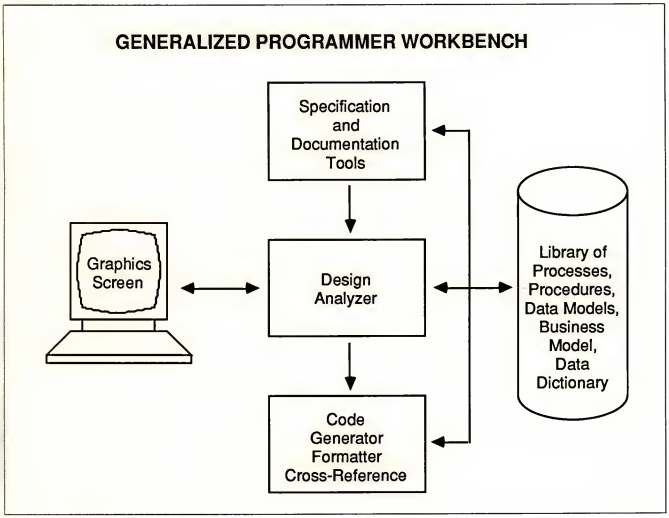
- Rand Information won the contract to design and implement the infrastructure. Other vendors are providing software products through an indefinite quantity contract with GSA.

- A generalized model of a computer-aided software programming workbench is depicted in Exhibit III-9.

The DoD is taking the lead in developmental artificial intelligence programs. AI is providing useful training for analysts, and applications are being employed in tactical situations and support functions. Civil agencies are also developing and operating expert systems for large-scale information processing.

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EXHIBIT III-9



4. The UNIX Solution

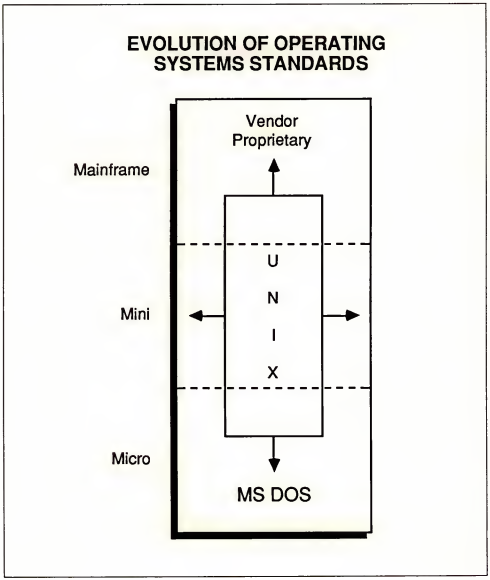
An issue of concern to agencies is the interoperability of software across different vendors' hardware. Some agencies believe UNIX provides a partial solution to this problem. As depicted in Exhibit III-10, UNIX offers a common operating environment for all sizes of hardware, from supercomputers to microcomputers.

References to a UNIX "standard" are now seen more frequently, although many authorities doubt the frequently quoted figures that 65% of the upcoming specs will specify UNIX.

- The Army's information systems standards include UNIX at both the organizational and work unit level. These standards are shown in Exhibit III-11.

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EXHIBIT III-10



- The Navy has expressed to INPUT a desire to specify UNIX "top to bottom" if the Navy could. Some procurements now require UNIX (e.g., the Navy/DLA EDMICS program).
- DoD security agencies will be major prospects due to interoperability and ADA requirements.
- ICST/NBS is working on a Portable Operating System (POSIX) UNIX-like standard.
- The IRS has been buying Microsoftware's XENIX for IBM's ATs, and NSA is running UNIX System V on AT&T's 3Bs.

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EXHIBIT III-11

ARMY INFORMATIONS SYSTEMS STANDARDS

TIER I - REGIONAL PROCESSING	
Operating system	- MVS
Data Base Management system	- Any DBMS with SQL interface
Hardware	- No standard defined
TIER II - INSTALLATION/ORGANIZATIONAL	
Operating System	- Unix5; or VM able to host CMS/VSE/MVS/Unix5
Data Base Management System	- Any DBMS with SQL interface
Hardware	- No standard defined
TIER III - USER PROCESSING	
Operating system	- Unix5 or MS-DOS
Data Base Management System	- No standard defined
Hardware	- PC shall be IBM-compatible
COMMUNICATIONS: Tiers I and II able to use IBM Systems Network Architecture (SNA) or SNA gateway with remote job entry (RJE), 327X emulation, and document interchange/document content architecture (DIA/DCA) and option for DoD protocols.	
ARTIFICIAL INTELLIGENCE (AI): Workstations for AI applications will be able to support "common LISP."	

Source: DAIM-AD
(Department of the Army Information Management)

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More-widespread adoption of UNIX could be slowed by several large hurdles.

- Agencies are reluctant to specify UNIX for fear that such a standard would unduly restrict competition and lead to more problems with vendor protests than agencies care to have. However, the GSBCA has upheld the viability of this approach.

- There is the question of the large installed base of applications built on vendor proprietary operating systems such as IBM's MVS. Agencies have neither the money nor the inclination to make this much software obsolete.

- Finally, a clear, standard UNIX environment is missing. Several versions (e.g., AT&T's, BSD's, XENIX) are on the market. Although they are more similar to one another than to other operating systems, the look of a single specification would only lead to the same type of mismatch agencies currently have.

It is INPUT's view that these issues will not readily be solved and that the evolution of a UNIX standard will compete with other approaches to software modernization, including fourth- /fifth-generation languages, data administration technologies, programmer's workbench, and the like.

5. Ada Usage

Greater acceptance and usage of the Ada language in major agency systems and the current proliferation of compilers are signs that Ada will continue to develop at a healthy rate. New directives from DoD, for example, make it increasingly difficult to obtain a waiver from the use of Ada in many areas, especially mission-critical applications. The Army, in particular, has stated that Ada is the software development language for projects in AWIS, MCS, and RCAS. Rather than waivers, program managers may be given extra time to develop Ada code. Other DoD agencies have also publicly supported Ada, although a more gradual transition seems favored.

Although most civilian agencies are not yet relying on Ada, NASA is very supportive. The software to be developed for NASA's space station project and SDI will require utilizing the Ada programming language.

D

Federal Software and Related Services Vendors

The enormous size of the federal market and the vast spectrum of products and services acquired attract a host of vendors. Whether covering a breadth of offerings or serving a niche, large and small vendors to the federal government must be counted among the competition. Numerous acquisition channels (GSA programs, sole-sources, competitive bids) and a regulatory structure intended to ensure equal opportunities for vendors

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provide each vendor with an attractive potential. However, the reality of the software and related services market is that a significant share is held by a few vendors.

- In the software products segment, the market is dominated by mainframe hardware vendors, primarily on the strength of their accompanying systems software. Independent software product suppliers form a distant second-tier group.

- Similarly, software development revenue from the government is largest for major systems houses that can offer a wide range of professional services. Niche vendors who target specific applications, operating systems, etc. form the second tier.

Exhibit III-12 depicts INPUT's estimates of revenue and share in the overall software and related services market.

- IBM heads the list on the strength of its FSS sales. Digital Equipment Corporation ranks first in sales of software products only. Computer Sciences Corporation and Radian Corporation are among the leading vendors for software development.

- Systems houses and professional services organizations round out the list.

- The important point of this exhibit is that no single vendor has a franchise in this market. Rather, the fifteen leading vendors account for only approximately 24% of the market.

Market share, indeed the competitive structure of the market, is complicated by the changing pattern of vendor teams for different programs. Today's bidding partners are frequently tomorrow's competitors, and vice versa.

E

Summary and Conclusion

The federal government's growing needs for software and related services will not abate through the forecast period. In fact, agency funding requests, planned initiatives, and regulatory changes all point to a fairly robust market for both software development services and, especially, software products.

But, outside of the FSS, the federal market is not easy to address. The distribution of available dollars among agencies is widespread, and each agency has specific software needs that are only infrequently addressable by a large number of vendors.

After vendors spend resources seeking these opportunities, they are likely to find long lines of competitors at the same doors. The final attractive-

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EXHIBIT III-12

ESTIMATED VENDOR REVENUE AND SHARE GFY 1987

VENDORS	FEDERAL SOFTWARE PRODUCTS 1987 (Percent)	FEDERAL SOFTWARE PRODUCTS 1987 (Percent)	FEDERAL SOFTWARE DEVELOP-MENT 1987 ($M)	FEDERAL SOFTWARE DEVELOP-MENT 1987 (Percent)	TOTAL FEDERAL SRS 1987 ($M)	TOTAL FEDERAL SRS 1987 (Percent)
IBM	20.9	4	92.4	9	113.3	6
Computer Sciences Corporation	0	0	54.3	5	54.3	3
BDM International	0	0	8.1	<1	8.1	<1
Grumman Data Systems	0	0	2.2	<1	2.2	<1
Digital Equipment Corporation	60.8	10	1.1	<1	61.9	3
EDS	0	0	9.4	<1	9.4	<1
Radian	0	0	34.1	3	34.1	2
Arthur Andersen	0	0	18.7	2	18.7	1
Unisys	7.0	1	13.4	1	20.4	1
Systems and Applied Sciences	0	0	14.9	1	14.9	1
CACI	1.1	<1	8.8	<1	9.9	<1
Computer Data Systems	0	0	11.3	1	11.3	<1
Honeywell	3.9	<1	13.2	1	17.1	1
Informatics General	6.9	1	4.9	<1	11.8	<1
E-Systems	0	0	6.9	<1	6.9	<1
Other Vendors	494	82	781	73	1270	76
Total Software and Related Service	595	100	1,075	100	1,665	100

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ness of the market and the diversity of agencies' needs has swelled the competitors' ranks.

In addition to competition on the basis of price and performance—a necessary condition in this market—vendors must also compete on the basis of their commitment to the offering, their general company image, and the level of support offered.

INPUT recommends that vendors not only concentrate on these competitive strategies, but also seek to enhance the desirability of products/services by closely aligning offerings with agencies' requirements. Understanding and addressing agencies' business needs, rather than a "generic, one-size-fits-all" sell, could lead to the capture of additional market share. Issues of transportability and interoperability of software are just two examples of issues that vendors should address opportunistically.

INPUT also recommends that vendors explore alternative distribution channels, such as systems houses and computer manufacturers. These types of vendors are learning the value of third-party distribution and are frequently looking for products/services to fill out their own offerings. Large vendors' size and market presence could prove beneficial to smaller vendors with unique products but without the resources to properly cover the opportunities.

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Agency Requirements and Trends

This section expands on the areas covered in Section III and provides more-detailed information on the directions federal agencies are taking in software acquisition and development.

A

Reasons for Type of Acquisition Selected

Respondents who indicated a preference or practice for acquiring packaged, modified, or custom software were asked to cite reasons for this choice.

- Packaged software buyers stated:
  - The applications are simple and general-purpose.
  - Packages are more cost-effective.
- Modified packaged software buyers stated:
  - The number of involved users implies a need to effect some modifications to available packaged software.
  - Enhancements are made to accommodate new or unique input/output devices.
  - It takes too long for custom developers to build systems.
- Custom-developed software buyers stated:
  - Unique requirements make it necessary to build unique products.

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- There is an in-house capability to develop software. That capability must be used or lost.

- The application is classified.

- Some agency executives want to be independent of the vendors' software approaches.

B

Expected Changes in Product/Service Acquisition Mix

INPUT believes that coming budget cuts, as well as a greater variety of available packages, will ultimately lead to an increase in the acquisition of packaged systems. However, approximately 50% of these respondents expect their agency's software product/service acquisitions to remain the same or in some cases to decrease, as shown in Exhibits IV-1 and IV-2. There are, however, some notable exceptions:

- By agency.

  - Both civil and defense agency respondents expect to increase their packaged applications software acquisitions and maintain or reduce both applications and systems that are custom developed.

  - Defense agency representatives, in general, expect to increase contract software maintenance, whereas civil agency representatives noted an almost equal split between maintaining/reducing and increasing software maintenance acquisitions.

- By type of product, especially among respondents who acquire both applications and systems software:

  - Packaged applications acquisitions are expected to increase while custom-developed applications are more likely to remain at their current levels.

  - Packaged and custom-developed systems software acquisitions are expected to remain at their current levels, although there appears to be an expectation that packaged systems software acquisitions could increase.

  - Contract maintenance will likely increase.

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EXHIBIT IV-1

EXPECTED CHANGES IN PRODUCT/SERVICE ACQUISITIONS BY TYPE OF AGENCY

PRODUCT/SERVICE CATEGORY	RESPONDENT GROUP/EXPECTED CHANGE (PERCENT OF RESPONDENTS)					
	CIVIL			DEFENSE		
	IN-CREASE	DE-CREASE	NO CHANGE	IN-CREASE	DE-CREASE	NO CHANGE
Packaged Applications	11	11	78	0	22	78
Packaged Systems	7	40	53	0	59	41
Custom Applications	16	40	44	18	53	29
Custom Systems	11	74	15	11	61	28
Contract Maintenance	3	45	52	0	30	70

- By type of acquisition (package, modified package, custom):
  - Packaged software buyers expect increases in applications acquisitions but not in systems acquisitions.
  - Packaged software acquirers also expect custom-developed applications to remain at the same level or to decrease.
  - Acquirers of modified packages and fully custom-developed software generally expect increases across the board.
  - A majority of respondents in these categories expect contract software maintenance to increase.

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EXHIBIT IV-2

EXPECTED CHANGES BY TYPE OF PRODUCT/SERVICE ACQUISITIONS

TYPE OF PRODUCT/SERVICE	EXPECTED CHANGE (Percent of Respondents)			TOTAL (Respondents)
	DECREASE	STAY SAME	INCREASE	
Applications Software	11	30	59	88
Systems Software	7	58	35	92
Packaged Software	6	31	63	93
Custom Software	14	57	29	87

In sum, agency respondents expect that contract maintenance acquisitions will increase along with packaged applications, custom applications, and packaged systems acquisitions. Custom systems software acquisitions will remain at their current level. In any case, mission-oriented software acquisitions are expected to grow at a faster rate than "general purpose" business software.

A subset of the respondents provided an indication of the extent of the expected change in software products/services acquisitions in the next two to five years.

Exhibit IV-3 indicates for this sample:

- A strong increase in packaged applications acquisitions.
- A more moderate increase in contract maintenance and packaged systems software.

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EXHIBIT IV-3

EXPECTED CHANGE OF NEAR-TERM PRODUCT/SERVICE ACQUISITIONS

PRODUCT/ SERVICE CATEGORY	Number of Respondents	CHANGE (Percent)		
		LOW	HIGH	AVERAGE
Packaged Applications	13	5	100	31
Packaged Systems	7	2	25	13
Custom Applications	7	-30	50	4
Custom Systems	3	-100	5	-35
Contract Maintenance	7	2	33	19

- Little change in custom applications development.
- A significant decline in custom systems development.

C

Size of Target Machine

Exhibit IV-4 indicates that the priority order of target machine sizes for software acquisitions is mainframes, micros, and minis, in that order. The differences were negligible between civil and defense agencies. However, agencies that acquired packaged software made acquisitions for all sizes of machines, whereas modified packages and custom-developed software went primarily on mainframe systems.

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EXHIBIT IV-4

SIZE OF RESPONDENTS' TARGET MACHINES

MACHINE SIZE	TYPE OF AGENCY (Percent of Response)	
	CIVIL	DEFENSE
Microcomputer	35	32
Minicomputer	24	29
Mainframe Computer	41	39

Federal agencies are now active in procuring software and related services for supercomputers. Agencies cited as the most active in the acquisition of software for supercomputers include: Energy, NASA, Air Force, and Army. These agencies will continue to require applications software to support their missions. The extent to which software and related services are acquired from sources external to the user or the particular facility operator will be dictated to a large extent by future funding and politics. The scientific and engineering applications will most frequently be provided or developed by the user or an incumbent contractor.

D

Software and Services Selection Criteria

Ratings of important factors in the selection of applications software vendors did not vary significantly by applications package users, all package users, or all respondents, as shown in Exhibit IV-5. However, several observations are noteworthy.

- Vendor training topped the applications users' group selection criteria but appeared in the middle rankings for the other two groups. Vendors' training offerings were rated most critical in applications software.

- Rankings for ease of use and product commitment by the applications group were stronger, although the three groups placed these criteria at or near the top of the list.

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EXHIBIT IV-5

PACKAGED SOFTWARE AND VENDOR SELECTION CRITERIA—APPLICATIONS SOFTWARE

CRITERION	RESPONDENT GROUP/RATING*		ALL-RESPONDENTS AVERAGE
	APPLICATIONS USERS	APPLICATIONS PACKAGE USERS	
Ease of Use	4.6	4.4	4.4
Product Commitment	4.6	4.4	4.4
Performance	4.4	4.3	4.3
Documentation	4.3	4.3	4.3
Training	4.9	4.1	4.1
Support Reputation	4.3	4.0	4.0
Service Quality	3.9	4.1	4.0
Software Features	4.3	3.9	4.0
Application Knowledge	4.0	3.9	3.9
Ease of Implementation	3.7	3.8	3.8
Product Price	3.6	3.3	3.3
Federal Experience Experience	3.0	2.6	2.7

*1 = Not Important; 5 = Very Important

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- The extent of federal experience needed by the vendor was given the lowest rank of each list, with price only one level above. For applications package software buyers, the quality of the product and the positive image of the vendor superseded these issues.

EXHIBIT IV-6

PACKAGED SOFTWARE AND VENDOR SELECTION CRITERIA—SYSTEMS SOFTWARE

CRITERION	RESPONDENT GROUP/RATING*		ALL-RESPONDENTS AVERAGE
	SYSTEMS USERS	SYSTEMS PACKAGE USERS	
Performance	4.5	4.2	4.5
Documentation	4.3	4.2	4.4
Product Commitment	4.5	4.0	4.4
Ease of Use	4.0	4.2	4.0
Support Reputation	4.0	3.7	3.9
Service Quality	4.1	3.5	3.9
Software Features	3.9	3.3	3.9
Application Knowledge	3.8	3.5	3.7
Training	3.9	3.5	3.7
Ease of Implementation	3.3	4.2	3.4
Product Price	3.1	3.2	3.0
Federal Experience	2.5	1.7	2.5

*1 = Not Important; 5 = Very Important

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Systems software package users, as shown in Exhibit IV-6, differed from all package users and all respondents in several ways:

- All ratings were generally lower for the package user group, reflecting the level of importance attached to applications packages.
- Packaged systems users ranked performance and product commitment highly.
- The vendors' federal experience criterion ranking again was very low for the systems group, with few agencies rating it above 1 on a scale of 1 to 5. Packaged software vendors do not need prior experience in this market, although a positive perception of the vendor is necessary.

By comparing civil to defense agency respondents, the relative importance of each criterion indicates some additional trends.

- The vendors' support reputation and service quality appeared more important to civil agencies that do not have adequate in-house staffs to maintain applications and software systems on their own.
- Product commitment was rated as very important in particular to civil and defense agencies buying applications packages but not to defense agencies buying systems software. Again, defense may be more able to rely on in-house capabilities to maintain products.

As shown in Exhibit IV-7, importance ratings for custom software vendor selection also indicated a marked difference between civil and defense agencies regarding vendor support. Although other rankings were similar, civil agencies placed greater importance on the vendor's reputation for support. Civil agencies also ranked target hardware and installation experiences somewhat higher, reinforcing the perception that civil agencies depend more on vendors to deliver complete, fully operational solutions.

Software performance as a selection criterion will increasingly mean more than answering the question, "Does the product do what we need?" Key criteria now include:

- Limiting the number of different software packages for each application to effect greater standardization and ease of data center support.

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EXHIBIT IV-7

VENDOR SELECTION CRITERIA
CUSTOM SOFTWARE

CRITERION	RESPONDENT GROUP/RATING*		ALL-RESPONDENTS AVERAGE
	CIVIL	DEFENSE	
Development Experience	4.2	4.6	4.4
Application Experience	4.2	4.3	4.3
Target Language Experience	4.1	4.4	4.3
Integration Experience	4.2	4.0	4.1
Training	4.0	3.9	4.0
Support Reputation	4.0	3.5	3.7
Target Hardware Experience	3.9	3.3	3.6
Installation Experience	3.6	2.8	3.2
Price	3.2	3.2	3.2
Federal Experience	3.1	2.5	2.8
Agency Experience	2.8	2.4	2.6

*1 = Not Important; 5 = Very Important

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- Standardizing the data exchange formats to effect file/data portability between applications.
- Adopting de-facto industry standard packages to ensure availability of I/O device drivers and packaged training programs and documentation.

E

Agency Use of New Software Developments

1. Ada Programming Language

The Department of Defense has increased its interest and efforts to promote the Ada programming language for data base applications throughout the government. Under DoD policy, Ada is required for all new large-scale initiatives unless the contractor can substantiate that the use of another approved higher-order language can be more cost- effective over the entire life cycle of the system. An additional DoD directive released in March, 1987 dictates policy for use of Ada in weapons systems.

The Army is the most supportive agency for the use of Ada as a means of improving software development from a managerial and technological perspective. Ada has served as a bridge to connect offices such as the Army weapons systems to the management information services for an exchange of technology and experiences. Implementation of Ada in the "field" is expected to occur during FY 1989.

Ada is currently employed in about ten major DoD systems, including personnel, logistics, and financial programs. Presently, there is some ongoing conversion from COBOL to Ada in the WWMCCS program, and Ada is also being incorporated into requirements in the MILPERCEN SIDPERS 3 project. Exhibit IV-8 is a list of the Army systems that use Ada.

Embedded systems and real-time applications are currently employing Ada, whereas agencies are also migrating toward decision support systems that use Ada. Support for Ada in non-mission-critical applications stem from the DoD directive released this year. The largest potential for Ada use is expected to be in the area of military communications programs throughout the DoD.

NASA will be the first civil agency to support Ada extensively. The software to be developed for NASA's space station project, and SDI will utilize the Ada programming language. The Treasury Department has some interest in investigating Ada for future use in its management information systems, such as payroll and personnel systems.

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EXHIBIT IV-8

CURRENT ARMY SYSTEMS USING ADA TECHNOLOGY

- Army WWMCCS Information System (AWIS).
- Maneuver Control System (MCS).
- Single-Channel Onboard Tactical Terminal (SCOTT).
- Army Tactical Command and Control System Common Hardware and Software (ATCCS CHS).
- Advanced Field Artillery Tactical Data System (AFATDS).
- Hellfire Missile.
- Reserve Component Automation System (RCAS).
- Howitzer Improvement Program.
- Forward-Area Air Defense Command, Control and Intelligence (FAADC^{2}I) System.
- Regency Net.
- Combat Service Support Control System (CSSCS).
- Standard Army Minicomputer Program.

Agency unfamiliarity with Ada, the different type of technology it represents, and its potential applications have prevented wider federal acceptance. This lack of acceptance is due in part to the agencies' shortage of trained personnel and experienced staff. As more Ada expertise is developed there will be more awareness of Ada and its potential usefulness.

From INPUT's interviews with the agencies and vendors, there appears to be an attempt to maintain a cooperative effort between government and

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industry to develop and implement Ada technology into the agency systems. Most major federal contractors are already qualified in Ada. Furthermore, the DoD is looking to industry to develop 4GLs for Ada that can be utilized for development and maintenance of applications exploiting relational data bases.

A recent Pentagon study suggested that the DoD mandate to use Ada may have been premature. Ada was initially overpromised, and DoD agencies could not use it because of slow maturation of the language and its compilers. Recently, the Pentagon has been unwilling to fund the large up-front costs if defense programs and contractors are to invest in Ada training, compilers, and software tool acquisition. The proposed defense budget cuts related to the current budget deficit measures are expected to have a major impact on early widespread use of Ada.

However, some DoD elements have ongoing initiatives to foster the use of Ada. For examples, through a 2-1/2-year-old contract with the Air Force, GE has developed some Computer-Aided Software Engineering (CASE) tools to improve the productivity of Ada software developers. This step is critical to wider Ada acceptance. As another example, the Software Engineering Institute (SEI), a DoD-funded research and development center at Carnegie Mellon University, has established an entire Ada-based software engineering program. This program includes the following projects:

- Ada Adoption Handbook Project
- Ada Embedded Systems Testbed Project
- Application of Reusable Software Components Project
- Dissemination of Ada Software Engineering Technology Project
- Evaluation of Environments Project
- Software for Reduced Instruction Set Computers Project
- Tools and Methodologies for Real-Time Systems Project

In addition, the SEI has recently begun the Ada artifact project, a search for a large-scale, delivered software system coded in Ada, to use as an educational vehicle.

2. Fourth-Generation Languages

Software products referred to as 4GLs are more accurately described as comprehensive software development facilities that are intended to extend the power of third-generation architectures and technologies. Fourth-generation languages (4GLs) are an integral set of familiar func-

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tions (DBMS, screen formatter, etc.) designed to assist end users with minimum technical knowledge in developing applications. Agencies have started to acquire 4GL packages as one means of offloading requests for ADP staff time.

The primary issues that are of initial and general concern to potential users of 4GLs are programmer productivity gains (both during the development phase and the maintenance cycle), performance and hardware resource considerations, and management issues. Within the government, however, serious consideration must also be given to the future impact of 4GLs from a conversion standpoint.

Agencies are finding that successful implementation of fourth-generation technology requires careful planning, administration, and management throughout the organization. Items such as policy and procedures, standards, data administration and security, etc. should be carefully established prior to implementation, and monitored and revised as necessary after implementation. Currently 4GLs are being used primarily for end-user computing and reports, with some small decision support. Many agencies are looking into 4GLs for additional applications.

The National Bureau of Standards (NBS) expects to publish a guide to selection of 4GLs, to go along with their 4GL Functional Model. Federal agencies should benefit from some guidance in this arena. Many agencies are looking for cost-justification data, selection criteria, or comparison reports. The lack of reliable data in this area makes selection of a product difficult, especially if an agency has not already made a commitment to a DBMS, or is looking for an end-user product with its own relational DBMS.

Other technical industry trends, however, may lead to a reduction in the use of 4GLs in the federal government. INPUT sees the growing popularity of Computer-Aided System Engineering (CASE) as a partial replacement for 4GLs. For example, an Arthur Andersen product called "INSTALL/1" is designed to replace a 4GL for applications development in the DB2/DBMS environment. In many cases, the close integration of CASE and DBMS products will obviate the need for 4GLs.

3. Artificial Intelligence

DoD is pursuing several developmental AI efforts, particularly in the intelligence sector. This sector needs to train analysts and incorporate new technologies that provide useful decision aids to improve productiv-

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ity. Artificial intelligence is gaining in usage in tactical situations, automated planning, and support applications. The DARPA Strategic Computing Program has employed AI in its Autonomous Land Vehicle (ALV), Pilot Associate, and Air/Land Battle Management (ALBM) projects. Furthermore, the armed services are each working on prototype projects primarily to assist with analysis and application of requirements. Many have already completed their initial studies and are about to proceed with their planned projects.

Large-scale information processing is the principle area of applications for AI in civilian agencies. These systems are mainly end-user production oriented and are standalone expert systems. The Internal Revenue Service has developed an expert system to assist in the processing and review of tax returns. The feasibility prototype was very successful and the use of AI to automate the auditing process will provide consistency and high-quality results to this production-oriented system. The Social Security Administration is also in the process of migrating its examination, processing, and approval of applications for benefits to an expert system. Exhibit IV-9 details several of the government agencies' artificial intelligence projects.

Other similar large-scale administrative activities in the federal government that apply knowledge and regulations/guidelines to specific processing areas are prime candidates for AI systems. These areas include licensing, forms processing, and coding and validation. Although standalone expert systems currently account for most of the AI development, eventually artificial intelligence will serve to link diverse sources of information to the agency's mainstream of data processing.

F

Impact of Standards

The following standards are important to federal agencies in developing strategies for software applications and achieving system portability:

- POSIX
- Ada Language
- UNIX
- Structured Query Language
- Open Systems Interconnection Protocols/GOSIP
- Standardization of Software Development

Much of the accomplishments in formulating these standards is coming from the joint efforts of NBS and industry. Currently, standards activity in the government is focusing on the adoption of a Federal Information

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EXHIBIT IV-9

FEDERAL AGENCY ARTIFICIAL INTELLIGENCE PROGRAMS

AGENCY	Department of the Army Ft. Huachuca, AZ	Department of Justice Federal Bureau of Investigation (FBI)	Health and Human Services Social Security Administration (SSA)	Securities and Exchange Commission (SEC) EDGAR Pilot program
FUNCTION OR AI SYSTEM	Automate analysis of problems on battlefield (Primarily classified system)	Investigative and administrative applications for personnel in field (Partially classified systems)	Examination and processing of applications	Analyzes financial information from electronically received corporate SEC filings
STATUS	2nd year of prototype operation	Initiated in 1984 Prototype and operational (Ongoing multiple projects)	Expect to be operational by 2 Q FY88	Prototype Award pending for operational phase
HARDWARE/ SOFTWARE	Symbolics Machine Lisp AI Language Environmental tools	Symbolics Machine Prolog AI Language	IBM PC and compatibles Expert System Shell Lisp AI Language	Symbolics Lisp Machine IntelliCorp's Kee Software Financial Statement Analyzer developed by Arthur Andersen and Co.
COMMENTS	• Expect use of AI milltarywide • Future nonclassified applications to include travel, claims processing, personnel, and contracting • Budgetary constraints impact on purchase of expensive equipment that is dedicated to this one environment	• Extensive use of custom software • Most successful in securing hardware and software from federally funded research and development centers • Experienced some lag in technology from commercial vendors • $10 million spent to date • Gramm-Rudman has slowed progress	• Installation of systems using PCs, thus minimizing expensive new hardware • Initial investments were for inexpensive packages • Use in highly visible applications that would represent substantial savings and/or improved efficiency	• Employs modular architecture to allow for ease of modifications • Natural language processing techniques used to locate and extract information • Reads the financial tables and footnotes in EDGAR's data base and presents results in the form of ratio calculations

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Processing Standard for portable applications development based on the Institute for Electrical and Electronic Engineers' draft POSIX standard. Agencies already have RFPs underway that are awaiting specifications for portable applications in conjunction with POSIX being adopted as a FIPS in January, 1988. NBS and industry representatives are still working on finalizing specific details of the standard.

The current Ada language form is outlined in the Reference Manual for Ada Programming Language MIL-STD-1815A. This manual incorporates the latest modifications and advancements to Ada design. The Ada language is employed for large-scale and real-time systems as mandated by the DoD, intelligence agencies, and some civilian agencies. Ada is useful for increasing productivity and for the development and maintenance of applications using relational data bases.

As a standard, Ada is designed to minimize problems in connecting with different hardware types and architectures. As already pointed out, the Army has taken the lead in using Ada in its systems. The largest future potential for use is in the military communications applications and in Space Station development programs.

UNIX continues to gain in popularity throughout the Federal government as it is perceived as a solution to incompatibility between hardware environments. Commercial application software packages are becoming more readily available, while the agencies continue to successfully develop their own custom software.

UNIX will remain of value as a software development system, particularly with super-minicomputers and mini-supercomputers. UNIX versions have also been customized to work on parallel computers. Other industry occurrences to impact on the UNIX user community are developments in the X Window graphics standard and the International Standards Organization networking standards.

The Air Force's $4.5 billion procurement of hardware and software in support of the Standard Multiuser Small Computer Requirements Contract (SMSCRC) led to an unsuccessful protest by Digital Equipment Corporation and Wang Laboratories. The protestors claimed that the Air Force illegally set the bidding requirement in favor of their competition (AT&T) by specifying an operating system that was functionally compliant with the UNIX System V Interface Definition (SVID).

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The General Services Administration Board of Contract Appeals (GSBCA) upheld the Air Force's RFP specifications for conforming to SVID as a legal equipment performance specification, but claimed other aspects of the RFP were ambiguous. This ruling reinforces the Air Force's reliance on the UNIX standard while waiting until the POSIX standard is fully developed. The protest decision removes obstacles for the government to proceed in its efforts to standardize operating systems.

Structured Query Language (SQL) is a relational data base language adopted by the American National Standards Institute (ANSI). SQL capabilities include defining, manipulating, and controlling data in relational data bases. It was ratified as ANSI 186 by the ANSI Database Committee after receiving broad industry acceptance and subsequently became a Federal Information Processing Standard.

An SQL module is useful for application development. It incorporates programmed interaction with relational data bases. The Army recently awarded a large contract for SQL-based data base management software in an effort to produce a high degree of interoperability with the Army's information architecture. SQL will also be used in personnel and logistics management systems.

OMB is mandating the use of OSI-compatible systems throughout the federal government. The issuance of a governmentwide policy for OSI will help to aggregate the market and establish consistency with commercial product development. The National Bureau of Standards in October, 1987 announced the Proposed FIPS PUB for the Government Open System Interconnect Protocol or GOSIP; the final approval is expected by January, 1988.

GOSIP runs in parallel with industry's OSI efforts for MAP/TOP application profiles and has as its foundation the protocols established by the International Standards Organization.

The FIPS would include protocol specifications, conformance tests, and user assistance directed to the federal agencies. It is anticipated that within two to five years, FIPS would be released for all seven protocol levels.

NBS estimates indicate that 70-80% of new system acquisitions in the early 1990s will be OSI-compatible. NBS regards vendor supply as the major constraint on the growth of this federal market segment.

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The DoD issued a policy memorandum in which it states a commitment to make the transition to OSI. A strong technical leadership position has been assumed by DoD. The DoD agencies see the need to move to OSI as necessary in order to be more efficient in the future.

After the eighteen-month transition period for GOSIP, all agency ADP and communications systems or services acquired that interoperate with other systems will be required to conform to OSI protocols.

Government standards activities are also focusing on reduction of software risk. Standardization in government contractors' software development will be impacted by DoD Standard 2167—which directs defense system software development, testing, documentation and evaluation of requirements—and its NASA counterpart, the Software Management Assurance Program. These recommendations and standards are an attempt by the government to share risk and are aimed at installing a specific set of procedures for contractors to promote development of high-quality, reliable software.

Industry observations, as well as those of GAO, are that the promotion of development procedures is a lesser priority of DoD software program problems. The more significant issue is the development of more-realistic requirements for the software that are not bound by Mil Specs written in a vacuum.

G

Acquisition Methods

Regardless of whether software was acquired as a package or through custom development by a professional services firm, the methods of acquisition include competitive bids, GSA Federal Supply Schedules, or purchase order.

As indicated in the top portion of Exhibit IV-10, differences exist in the frequency with which agencies acquire different types of packages.

- Competitive bids are more frequently employed than the other alternatives, and defense agencies make more frequent use of the competitive approach than do civil agencies.
- Typically, packages that will be modified are most frequently acquired by competition.
- Applications software is also more frequently purchased competitively, with many of the systems software buys tied to the hardware, not to standalone software.

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EXHIBIT IV-10

RATINGS OF FREQUENCY OF USE OF VARIOUS ACQUISITION METHODS

SOFTWARE PACKAGES

ACQUISITION METHOD	AVERAGE RATINGS BY GROUP*							ALL RESPONDENTS
	AGENCY		PRODUCTS			ACQUISITION		
	Civil	Defense	Application	System	Both	Package	Modified	
Competitive Bid	3.7	4.0	4.4	3.4	3.8	3.8	4.1	3.8
GSA Schedule	3.5	3.3	3.1	3.4	3.5	3.5	3.2	3.4
Purchase Order	3.0	2.3	2.3	3.2	2.8	2.9	2.3	2.8

PROFESSIONAL SERVICES

ACQUISITION METHOD	AVERAGE RATINGS BY GROUP*						ALL RESPONDENTS
	AGENCY		PRODUCTS			ACQUISITION	
	Civil	Defense	Application	System	Both	Custom	
Competitive Bid	3.5	3.7	4.0	3.0	3.6	3.0	3.6
GSA Schedule	2.9	3.2	3.0	3.5	3.0	2.0	3.1
Purchase Order	2.6	1.9	1.4	3.0	2.5	1.0	2.3

* 1 = Not frequently used; 5 = Quite frequently used

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- GSA Schedule Orders and Direct Agency Purchase Orders, while used less frequently across the board, do provide opportunities for all types of package vendors. Additional frequent usage of GSA schedules is noted in civil agencies and for systems software.

Professional services acquisition methods (lower table in Exhibit IV-10), with one exception, follow the same order of frequency of method (bid, schedule, purchase order) regardless of agency or type of software to be developed. The exception is the custom development of systems software, in which case employing GSA supply schedules is the most frequently used approach.

H

Testing and Acceptance Procedures

The favorite testing and acceptance procedure—regardless of the type of product or service, method or acquisition, or classification of agency respondent—is a trial period. This practice is followed less frequently by benchmarking, parallel testing, or independent verification and validation (IV&V), as shown in Exhibit IV-11. IV&V, in particular, was reported as very infrequently used except for civil agencies and agencies acquiring systems software.

Benchmarking is costly, but sometimes the only appropriate testing procedure. A 1982 GAO study ("Benchmarking: Costly and Difficult, But Often Necessary When Buying Computer Equipment or Services" GAO/AFMD-83-5 (10/22/82) B-208077) of 65 benchmarks indicated that the typical benchmark cost (external cost only) ranged between $40,000 and $200,000, but in GAO's opinion was the only appropriate test procurement. Much of the cost, however, stemmed from agency errors in benchmark programs, poor documentation, and difficulties in communicating with the agency in resolving technical issues caused by the first problem. GAO recommended that, when appropriate, other evaluation methods be used. In order of increasing cost, these methods include:

- "Paper" or technical evaluation
- Analytical modeling
- Simulation

INPUT reconfirmed this view with GSA. As of December, 1987, there has been little change in benchmark policy. Agencies must, of course, be mindful of GAO's auditing standards in that some agency systems may be subject to GAO audit. These audits are specifically designed to assess the reliability and, therefore, the degree of risk involved in using computer-processed information. Various data reliability tests are performed

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EXHIBIT IV-11

RATINGS OF FREQUENCY OF USE FOR VARIOUS TEST AND ACCEPTANCE PROCEDURES

SOFTWARE PRODUCTS								
	AVERAGE RATINGS BY GROUP*							
	AGENCY		PRODUCTS			ACQUISITION		
ACQUISITION METHOD	Civil	De-fense	Appli-cation	System	Both	Modi-fied Pkg.	Modi-fied	ALL RESPON-DENTS
Trial Period	3.8	4.5	4.0	4.4	4.1	4.0	4.1	4.1
Benchmark	3.4	4.2	4.3	4.2	3.6	3.6	3.9	3.7
Parallel Testing	3.0	2.8	2.5	3.8	2.9	2.9	3.2	3.0
IV and V	2.9	2.3	2.0	2.8	2.7	2.7	2.8	2.6
PROFESSIONAL SERVICES								
Trial Period	3.3	4.6	4.0	4.5	4.4	3.9	5.0	4.3
Benchmark	3.8	4.0	3.7	4.5	3.9	3.6	5.0	3.9
Parallel Testing	3.2	3.1	2.7	4.0	3.2	3.1	3.0	3.1
IV and V	3.1	2.0	2.2	4.0	2.7	2.3	2.0	2.6

* 1 = Not frequently used; 5 = Quite frequently used

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by auditors on a timely basis to ensure the relevancy, accuracy, and completeness of computer output.

I Postimplementation Support

An important part of the vendor selection process is the vendor's reputation for supporting the client and the product. In this research, the ranking of those considerations, as shown in Exhibit IV-12, was:

- Fixing errors
- Improving features/functions
- Training
- Extending features/functions
- Adding features/functions
- Consulting

With few exceptions, the rankings were high, indicating a high level of expectations for vendor support services. There was little variation in the rankings; regardless of groupings, all the following variations are noteworthy.

- Compared to defense agency respondents, civil respondents believe fixing errors and consulting services are more important. Again, this belief reflects civil respondents' lack of in-house personnel to fulfill these functions.

- Applications software users ranked all factors higher than systems software users. This ranking seems to reflect the fact that systems software is more transparent to users than are applications. Training adds additional features/functions that are particularly important to applications users.

- Interestingly, training is not seen to be as critical for custom-developed software as for packaged software. Perhaps the close association with the professional services vendor over the development period provides some of the training that agencies would otherwise require.

- Consulting services provided by package software vendors is more important since the package buyer looks for advice in selecting a package. In custom development work, the associated consulting services (design, requirements definition) have usually been delivered prior to the actual development.

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EXHIBIT IV-12

RATINGS OF IMPORTANCE OF VENDOR REPUTATION FACTORS IN POSTIMPLEMENTATION SUPPORT

SOFTWARE PRODUCTS

	AVERAGE RATINGS BY GROUP*								
	AGENCY		PRODUCTS			ACQUISITION			
FACTOR	Civil	De-fense	Appli-cation	System	Both	Pack-age	Modi-fied Pkg.	Cus-tom	ALL RESPON-DENTS
Fixing Errors	4.7	4.2	4.7	4.0	4.5	4.6	3.9	4.5	4.5
Improve Features/ Functions	4.1	3.9	4.4	3.3	4.0	4.1	3.7	4.5	4.0
Training	4.0	4.1	4.9	3.2	4.0	4.1	3.9	3.5	4.0
Extend Features/ Functions	3.8	3.8	4.1	3.2	3.8	3.8	3.7	4.0	3.8
Add Features/ Functions	3.8	3.8	4.3	3.3	3.8	3.9	3.6	4.0	3.8
Consulting	3.7	3.1	2.7	3.2	3.7	3.5	3.7	2.5	3.5

* 1 = Not Important; 5 = Very Important

Most respondents did not feel that vendors offered services beyond those listed above, but some examples of additional services identified included systems design/analysis, installation, programming, and data entry.

When asked if vendors' problem resolution had proven to be "satisfactory," 77% of the respondents said it was.

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- Among those who said it was not satisfactory came the following suggestions for improvement:
  - A more knowledgeable sales staff that shows more interest.
  - More-efficient contracting methods.
  - More and better support.
  - Faster service response.
  - Postimplementation following-through on commitments made at the time of sale.
- Respondents were equally divided on the question of whether vendors could improve problem resolution performance. The cynics among the respondents felt poor performance was "just a part of business" and a matter of "economics" for the vendors.

J

Self-Support

Self-support provides an alternative to costly or unavailable vendor support. To assess the frequency with which agencies engage in self-support activities, respondents were asked to identify, on a scale of 1 to 3—worded as "Never," "Sometimes," and "Usually"—their level of self-support.

- Exhibit IV-13 shows, in general, that installation of updates is usually completed by the agency, but other self-support activities are undertaken less frequently.
- Defense agencies appear to engage in less self-support, perhaps because more of the work is contracted out.
- Those who acquire packages, on the other hand, tend to provide more self-support.

In looking at future directions, these groups expected little change in frequency of self-support.

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EXHIBIT IV-13

RATINGS OF FREQUENCY OF USE OF TYPES OF SELF-SUPPORT USED WITH SOFTWARE PACKAGES

	AVERAGE RATINGS BY GROUP*							
	AGENCY		PRODUCTS			ACQUISITION		
SELF SUPPORT ACTIVITIES	Civil	De-fense	Appli-cation	System	Both	Pack-age	Modi-fied Pkg.	ALL RESPON-DENTS
Install Updates	2.8	2.4	2.7	3.0	2.6	2.6	2.6	2.6
Centralize Questions	2.4	2.3	1.8	2.3	2.5	2.4	2.0	2.4
Install Release	2.4	2.0	2.0	2.5	2.2	2.3	1.9	2.2
Modify Package	2.1	1.9	2.2	2.7	1.9	1.8	2.6	2.0
Fix Errors	2.1	1.9	2.2	2.5	1.9	1.9	2.1	2.0

* 1 = Never; 3 = Usually

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Competitive Trends

The preceding sections provide a view of the federal government market for software and related services from the agencies' perspectives. In this section, the same market is examined by representative vendors' opinions and contrasted with the agencies to develop an understanding of the opportunities and concerns encompassing this market.

A Vendor Participation

1. GSA Program Participation

GSA frequently acts as the intermediary between vendors and individual agency buyers through a series of programs designed to simplify the contracting process, including the specification of approved products/services and the establishment of governmentwide prices for products/services. Schedule 70 of the Federal Supply Schedule (FSS) provides a program vehicle for agencies to acquire, among other things, computer equipment purchases and rental; equipment maintenance repair and spare parts; and software rental, purchase, and maintenance.

- The leading hardware vendors selling software products via FSS 70A in government fiscal year 1987 are listed in Exhibit V-1. Leading Schedule 70A independent software vendors are presented in Exhibit V-2.

- As noted throughout this report, systems software is frequently acquired with the hardware from the hardware manufacturer. This situation is reflected in Exhibit V-1, which credits hardware suppliers IBM, Digital, Hewlett-Packard, and Unisys, as being leading GSA Schedule 70A software products vendors.

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EXHIBIT V-1

LEADING GSA SCHEDULE 70A SOFTWARE PRODUCTS VENDORS GFY 1987

VENDOR		SOFTWARE RENTAL, PURCHASE, AND MAINTENANCE ($M)
IBM		581.3
Digital Equipment		251.4
Hewlett-Packard		77.7
Unisys:		42.8
Sperry	30.7	
Sys. Dev.	12.1	
Data General Corp.		17.8
Gould Inc.		12.7
Tektronic		8.0
Harris Corp.		7.3
Xerox		6.6
Tandem Computers		3.4
Control Data		1.6
Concurrent Computer Corp.		0.4

Updated 12/87

- Except for Oracle, Computer Associates, and Software AG, leading independent vendors achieve revenue volume only on a par with the smallest hardware vendors. Although these vendors should not overlook this revenue source, they must pursue other strategies that include individual contracts with agency buyers and relationships with leading computer/hardware manufacturers.

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EXHIBIT V-2

LEADING GSA SCHEDULE 70 INDEPENDENT SOFTWARE VENDORS

VENDOR	FISCAL YEAR 1987 DOLLAR VOLUME ($ MILLIONS)
Oracle	8.2
Computer Associates	4.4
Software AG	2.7
UCCEL	1.5
CINCOM	0.8
Information Builders	0.8
Sterling Software*	0.5
Duquesne	0.5
Pansophic	0.4
ADR (Ameritech)	0.4
On-Line Software	0.4

* Includes both Informatics General Corporation and Sterling Software Marketing

Two other GSA programs of note and the participating vendors are included in Exhibits V-3 and V-4.

- The Contract Services Program (CSP) provides for the acquisition of professional services, primarily software development, to support the ADP requirement in each of the GSA regionals. Individual task contracts have been awarded for up to $1 million, but contracts of between $100 and 500 thousand are more typical. Contracts are awarded for a one-year base period, with two or three possible one-year option add-

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EXHIBIT V-3

GSA CONTRACT SERVICES PROGRAM (CSP)

CURRENT AWARDS	REGION
Vanguard Technologies Corporation	1
CRC Systems	1, 2, 3, and NCR*
CDSI	1, 2, 3, 4, 5, 6, and NCR
Computer Data Systems, Inc.	2
Computer Dynamics	2 and 3
Computer Data Systems, Inc.	3
Computer Sciences Corporation	4
Computer Dynamics	4
Kentron	4, 5, 6, 7, and 8
Systems and Applied Sciences Corporation	5
OAO Corporation	6
OAO Corporation	7
Systems and Applied Sciences Corporation	8
Martin Marietta	8, 9, and 10
Planning Research Corporation	9
CRC Systems	9 and 10
Computer Sciences Corporation	10
Planning Research Corporation	NCR
AMS	NCR
Vanguard Technologies Corporation	NCR

* National Capital Region

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ons. A total of $131 million was awarded for CSP during fiscal year 1987.

- Current contractors under this program are listed in Exhibit V-3. The GSA reorganization from eleven regions to five zones will take effect as the current contracts expire. Solicitations are expected to be released from 1987 through the end of 1989.

- System software products contractors for the Programmers WorkBench (PWB) Program of the GSA Federal Software Management Support Center (FSMC) are listed in Exhibit V-4.

  - In this program, GSA has distribution rights based upon a negotiated price for a period of one year with four one-year options.

  - Although vendors are required to provide training and maintenance for one year, software problems are routed through GSA to Rand Information (the chief architect of the workbench), and from there to the vendor.

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EXHIBIT V-4

FEDERAL SOFTWARE MANAGEMENT SUPPORT CENTER PROGRAMMERS' WORKBENCH PRODUCTS

TOTAL CATEGORY	SUPPLIER
PWB/Base Configuration	Rand Information Systems, Inc.
PWB/Data Base Configuration	Rand Information Systems, Inc.
Test Coverage Monitor	Aldon Computer Group
Translator	Computer Associates
Reformatter	Blackhawk Data Corporation
Data Standardization	Marble Computer, Inc.
Cross-Reference	Marble Computer, Inc.
Documentation	Peat Marwick/Catalyst
Source & File Compare	Sterling Software Corporation
Data Manipulation	XA Systems Corporation
Restructurer	Peat Marwick/Catalyst
Code Analyzer	VIASOFT, Inc.

Source: GSA Federal Software Management Support Center

Updated 12/87

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2. General Market Participation

The federal government as an entity is the largest purchaser of professional services and thereby attracts the widest range of vendors by size and specialization. Exhibit V-5 indicates the leading vendors by market share to the extent that this portion of their federal revenue is identifiable.

- The market is dominated by system houses and hardware firms. These firms require a broad range of in-house or consultant skills to meet software development and implementation requirements. Hardware firms primarily provide systems software, with applications software packages and software development as secondary lines of business. Vendor respondents commented also that an average of 40% of a systems integration or turnkey system project is allocated for software and related services.

- Bidding strategies for the software mode are different than for other service modes for several reasons:

  - A primary requirement is availability and commitment of key qualified managers and professionals.

  - There is an increasing tendency toward the use of fixed-price bids on late development and the implementation phases of new or replacement systems.

  - Some specialized small businesses, consulting firms, and academic groups are key to an award if the agency believes that only specialized organizations have the requisite background or functional experience.

  - In-depth support of the main body of employees and managers can be a key criterion.

  - Reputation has high value in this service mode, especially for cost control, management commitment, staff quality, and availability.

Vendor knowledge of available and applicable software packages that can be fitted to agency requirements can be a deciding factor in some bids. A thorough knowledge of government contracting procedures, audit requirements, and bid evaluation processes is also essential to maximize proposal scores for negotiated procurements. In-depth knowledge of, and exposure to, agency mission and system functional requirements are important elements for establishing credibility with the potential client.

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EXHIBIT V-5

ESTIMATED VENDOR REVENUE AND SHARE
GFY 1987

VENDORS	FEDERAL SOFTWARE PRODUCTS 1987 ($M)	FEDERAL SOFTWARE PRODUCTS 1987 (Percent)	FEDERAL SOFTWARE DEVELOP-MENT 1987 ($M)	FEDERAL SOFTWARE DEVELOP-MENT 1987 (Percent)	TOTAL FEDERAL SRS 1987 ($M)	TOTAL FEDERAL SRS 1987 (Percent)
IBM	20.9	4	92.4	9	113.3	6
Computer Sciences Corporation	0	0	54.3	5	54.3	3
BDM International	0	0	8.1	<1	8.1	<1
Grumman Data Systems	0	0	2.2	<1	2.2	<1
Digital Equipment Corporation	60.8	10	1.1	<1	61.9	3
EDS	0	0	9.4	<1	9.4	<1
Radian	0	0	34.1	3	34.1	2
Arthur Andersen	0	0	18.7	2	18.7	1
Unisys	7.0	1	13.4	1	20.4	1
Systems & Applied Sciences	0	0	14.9	1	14.9	1
CACI	1.1	<1	8.8	<1	9.9	<1
Computer Data Systems	0	0	11.3	1	11.3	<1
Honeywell	3.9	<1	13.2	1	17.1	1
Informatics General	6.9	1	4.9	<1	11.8	<1
E-Systems	0	0	6.9	<1	6.9	<1
Other Vendors	494	82	781	73	1270	76
Total Software and Related Service	595	100	1,075	100	1,665	100

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The software products segment of the market is led by computer manufacturers with independent software package vendors ranked as distant seconds, as shown in Exhibit V-5. This ranking includes systems and applications software products.

- Key strategies for selling software products in the federal arena are not uniformly practiced by all of the successful vendors, but some combinations apply.
  - Discounts for multiple sites within an agency have become a requirement.
  - Discounts for multiple agencies within a cabinet-level department also apply.
  - Beta testing of applicable products by key agencies permits placement on the Qualified Products List (QPL) for future accelerated acquisition.
  - Qualification for the GSA Federal Supply Schedules (FSS) sometimes permits uncontested acquisition in small lots. The "ground rules" for an FSS annual agreement have some serious drawbacks, however:
    - The vendor must offer product/service discounts as large as those received by the vendor's "best customer," including foreign clients.
    - The vendor must offer a purchase plan or permanent license after a specified rental period.
    - The vendor must offer postinstallation service and support on a nearly universal basis.
- Demonstrated postimplementation support, especially of the "Quick Reaction" (QR) type.
- Availability of the package for several host machines, especially for agencies with a variety of CPUs.
- A continuing client education program to "let them know your products' capabilities." (There is some brand name loyalty.)

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3. Ada Vendors

Growing interest in the segment of the software and related services market requiring Ada dictates a closer look at the participating vendors. Exhibit V-6 lists major Ada vendors ranked by the number of validated Ada compilers each vendor offers. Although this ranking does not relate directly to revenue realized from this segment, it does provide an indication of vendor commitment.

EXHIBIT V-6

MAJOR ADA COMPILER VENDORS

VENDOR	NUMBER OF VALIDATED COMPILERS
Alsys	17
Verdix	17
Systems Designers Software	7
Honeywell	7
Irvine Compiler	7
Meridan Software Systems	6
Telesoft	5
Intermetrics	5
Harris	4
Softech	4

Source: Ada Information Clearinghouse Updated 12/87

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The top two vendors expend nearly 100% of their resources in the development, marketing, and sales of Ada products. For other vendors the effort is considerably smaller. Altogether, there are over 20 organizations offering at least one validated Ada compiler. Over 130 validated Ada compilers are now available covering nearly every size of machine.

Ada compiler vendors will soon be subject to the test procedures and evaluation system known as the Ada Compiler Evaluation Capability (ACEC). The ACEC evaluation is based on the execution time for specific Ada constructs and measurements of compiler performance on programs that represent mission-critical applications. The compiler evaluation test suite will be managed by the Air Force and the first release is expected in August, 1988.

B

Vendor Market Perceptions

In the opinion of vendors interviewed by INPUT, the federal software and related services market will stay strong in the near term. Although vendors are typically optimistic in their growth forecasts, Exhibit V-7 indicates some agency/vendor agreement about growth trends.

EXHIBIT V-7

AGENCY VERSUS VENDOR EXPECTATIONS OF PERCENTAGE CHANGE IN NEAR-TERM PRODUCT/SERVICE ACQUISITIONS

PRODUCT/SERVICE CATEGORY	AVERAGE CHANGE (PERCENT)	
	AGENCY	VENDOR
Packaged Applications	31%	32
Packaged Systems	13	10
Custom Applications	4	20
Custom Systems	-35	8

Updated 12/87

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Agency and vendor respondents agree that packaged software represents the fastest-growing segment, and both groups agree that packaged applications, in particular, will grow at a rate of over 30% annually. The two groups also have similar views on the moderate growth of the packaged systems software.

- If vendors are using history as a base for optimism, they would do well to remember that government fiscal years 1983 through 1986 were a period of significant government activity focused on upgrading and replacing obsolete hardware and its necessary systems software. Such a period of activity may not occur again until the early 1990s.

- On the issue of definition, the data includes vendors who offer data base management systems that INPUT classifies as systems software. Respondents from agencies may have viewed these types of systems in terms of their ultimate applications, and thus classified them with applications software, leaving only operating systems, system tools, and productivity aids in the systems category.

The agency and vendor respondents share the opinion that custom development of software will not grow at the same fast rate of packaged software. The two groups differ, however, in the rate of change expected. Agency respondents forecast only minimal (4%) growth in the purchase of custom applications, but vendors believe growth will be a healthy 20%. INPUT estimates, based on the proposed programs of the various federal agencies, put the growth at 17%.

The most dramatic agency/vendor difference in growth perception regards custom development of systems software. This difference may be definitional as discussed above, with agencies thinking "operating systems" and vendors responding to the view that much of the custom activity is completed under the umbrella of "system integration" in which the replacement, upgrade, or new start includes hardware, systems software, and applications development.

In interviews with software developers for supercomputer hardware, vendor respondents identified an increasing variety of applications and operations software that is becoming available to support the government's operation of supercomputers. There is also more frequent use of professional services in selection and design of application software to satisfy particular user requirements.

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The market for operational and applications software especially designed for supercomputers is beginning to grow. Software for scientific computations, computational fluid dynamics codes, structural codes, and other performance-type applications are examples of applications software being produced. Communications software packages are also being developed, as well as various operational software packages.

Artificial intelligence is a market segment in which vendors are focusing on introducing new technology to the government primarily in the areas of software development efforts and decision support. Currently, expert systems are being developed by agencies as standalone end-user production systems to automate knowledge-based processing.

Industry respondents view the current AI opportunities to be in product-oriented services for prototyping systems for the federal agencies. As in other software areas, the government is looking to industry for solutions, not just products. Therefore, in response to this trend, AI vendors will migrate beyond standalone systems to new products that integrate approaches and solutions. AI will develop closer links to the main flow of an agency's information processing.

Many small AI vendors are focusing their marketing efforts on MIS directors providing products to facilitate information storage and retrieval, data communication, and other typical MIS functions. Current federal prototyping efforts are demonstrating AI feasibility in those MIS functions as well as other decision support areas. Areas in which federal workers must interview the public seem especially promising for AI.

C
Vendor Selection Criteria

As shown in Exhibit V-8, agency and vendor respondents indicate only moderate agreement with respect to the relative importance of criteria used by agencies in the selection of vendors from which to purchase packaged applications software. There is agreement that the primary concern is for the operation of the software. The factors "ease of use" and "performance" are also highly rated by both groups.

The characteristics directly related to the software (i.e., documentation, features, ease of implementation, and price) also found general agreement, with two exceptions.

- Software documentation is ranked higher by vendors than by agencies. This is surprising, given the frequent complaints agency clients express about the quality of software documentation.

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EXHIBIT V-8

AGENCY VERSUS VENDOR RATINGS OF FACTORS IMPORTANT IN THE SELECTION OF PACKAGED APPLICATIONS SOFTWARE VENDORS

FACTOR	AVERAGE RATING*	
	AGENCY	VENDOR
Ease of Use	4.4	5.0
Product Commitment	4.4	4.0
Performance	4.3	5.0
Documentation	4.3	4.4
Training	4.1	4.5
Support Reputation	4.0	4.8
Service Quality	4.0	4.8
Software Features	4.0	4.2
Application Knowledge	3.9	4.6
Ease of Implementation	3.8	4.0
Product Price	3.3	4.4
Federal Experience	2.7	3.8

*Rating: 1 = Least Important; 5 = Very Important

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- The price of software receives a higher ranking by vendors than by agency representatives. It is reasonable that vendors are sensitive to the issue of price, particularly in dealing with the federal government. However, with the limited funds with which agencies have to work and the nearly across-the-board mandate that outside service be purchased on a competitive basis (the next-to-last ranking), agencies seem to be indicating that price is a "necessary," but not a "sufficient" criterion for selection (an opinion that may not be shared by contracting officers).

The general category of support (training, support reputation, service quality, and commitment to the product) is perceived by vendors to be more important than it reportedly is to agencies.

- Only the criterion of training among this support grouping is rated by both sets of respondents as moderately important.

- Vendors rate service quality and support reputation among the highest agency criteria, but the agencies actually rate these two as only moderately important.

The biggest difference in this category, however, is in the respective ratings of the importance of product commitment as a selection criterion. Vendors, with an apparently shorter view of product life, thought agencies would rate this criterion among the lowest. Agencies, ever mindful of the effort required to fund and then implement applications software, look for vendors to maintain the specific software in the vendor's active product line for some time. It is important that vendors have product expansion plans—including management teams, R&D budgets, and an understanding of changing requirements in place—and be able to articulate these to buyers.

Finally, respondents differ on the importance of the vendor's level of applications experience as a criterion, but did agree that the vendor's federal experience is not an issue.

- Both groups agree on the lack of importance of the vendor's federal experience, rating it last among the 12 criteria.

- Application experience was perceived by vendors to be important to the agencies, while agency respondents actually rated this criterion quite low. Apparently, applications software vendors cherish their knowledge of the ability to develop software for specific applications and think that agencies will hold these experiences in high regard as well.

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Agencies, on the other hand, assume that any packaged applications software being considered will have the applications knowledge behind it and, further, that the proof is in the performance, not in the vendor.

As shown in Exhibit V-9, the ratings of agencies and vendors regarding agencies' selection criteria for packaged systems software indicated a ranking similar to those of packaged applications software, but with some notable exceptions. Although the general group of factors relating to the software is ranked second to actual software use, the specific factors of ease of implementation and price were ranked high on the vendors' perception list and low on the agency respondents' list.

Agencies do not seem to make an issue of implementation, either because they assume vendors can and will install the software or because they assume their agency's staff will be capable of installing it. With the many stories about man-year efforts to install what was thought to be straightforward systems, vendors seem to be accurate in holding the issue of implementation high on their list.

Differences exist in ratings for the remaining factors. For price, it appears that vendors are more sensitive to the issue, but agencies believe their systems software needs outweigh the cost of meeting their ADPE objectives. In the category of support criteria, vendors perceive service quality and training as more important than agencies actually ranked them, and product commitment as less important than it is (see the discussion above). The factor of experience was ranked fourth as a group and, again, vendors perceived their knowledge of the application as more important than agencies did.

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EXHIBIT V-9

AGENCY VERSUS VENDOR RATINGS OF FACTORS IMPORTANT IN THE SELECTION OF PACKAGED SYSTEMS SOFTWARE VENDORS

FACTOR	AVERAGE RATING*	
	AGENCY	VENDOR
Performance	4.5	4.6
Documentation	4.4	4.6
Product Commitment	4.4	3.6
Ease of Use	4.0	4.6
Service Quality	3.9	4.6
Software Features	3.9	4.2
Support Reputation	3.9	3.8
Application Knowledge	3.7	4.0
Training	3.7	4.0
Ease of Implementation	3.4	4.6
Product Price	3.0	4.2
Federal Experience	2.5	3.4

*Rating: 1 = Least Important; 5 = Very Important

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The rankings of factors for the selection of vendors of custom software development are presented in Exhibit V-10. For clarity, the factors were grouped into the categories "vendor capabilities" (previous experience in development, integration, and installation; experience in the specific application; and experience with the target language and target hardware), "vendor enhancements," and "vendor federal experience."

EXHIBIT V-10

AGENCY VERSUS VENDOR RATINGS OF FACTORS IMPORTANT IN THE SELECTION OF CUSTOM SOFTWARE VENDORS

FACTOR	AVERAGE RATING*	
	AGENCY	VENDOR
Development Experience	4.4	4.6
Application Experience	4.3	3.8
Target Language Experience	4.3	4.0
Integration Experience	4.1	4.1
Training	4.0	3.6
Support Reputation	3.7	4.3
Target Hardware Experience	3.6	3.9
Installation Experience	3.2	4.4
Price	3.2	4.3
Federal Experience	2.8	3.8
Agency Experience	2.6	3.2

*Rating: 1 = Least Important; 5 = Very Important

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Agency and vendor respondents agreed that the vendor's development experience was the most important selection criterion. Both groups reported similar rankings for integration experience, placing it in the upper one-third of the list, and for hardware experience, placing that criterion in the lower one-third of the list.

However, the other criteria in the "vendor capabilities" grouping were nearly opposite. Agencies put more weight on the vendor's experience in the specific application area and on the experience of the vendor with the target language. Vendors rank these two factors near the bottom of the capabilities group, replacing them with the importance of installation experience.

Therefore, it seems that the "buyers" are looking for specific capabilities that will ensure that the development effort in question may be effectively and efficiently done by the vendor. The vendors, on the other hand, hope to "sell" their general installation experience instead. Although it seems only natural that vendors would want their general capabilities recognized, these rankings indicate that, to be most successful, vendors must also become thoroughly familiar with the specifics of a given opportunity and translate their general capabilities into the specifics of the opportunity.

Consistent with the above rankings, vendors also perceived that "vendor enhancements" would be more important to agencies than they actually appear to be.

- Price and support reputation were rated in the top third by the vendors but only in the middle third by the agencies.
- Similarly, training was given a relatively high ranking by the agencies, vendors thought it would appear near the bottom of the criteria.
- Again it seems that vendors are sensitive to competition based on price and the need for quality support rather than some of the "vendor capabilities" listed above, while agencies are concerned about the vendor's capability to do a specific job, regardless of the enhancements that the vendor may bring to the assignment.
- Both groups agree that the vendor's federal experience and experience with the specific agency are among the least important criteria.

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D

Acquisition Methods and Test and Acceptance Procedures

Most of the vendors interviewed indicated that their standard software services are most frequently purchased by the federal government through competitive bidding. This is entirely consistent with the agency respondents' statements that competitive bidding is the most frequently used acquisition method. The next most frequent method is the GSA Schedule.

For custom services and software products, again the competitive bidding process is reported to be used most frequently, and the GSA Contractor Support Program was mentioned as used next most frequently. Furthermore, respondents were of the opinion that on the average the government purchases 30% operating systems and 70% application software.

Vendors did differ from agency respondents in the perceived frequency of usage of various test and acceptance procedures. Although agencies reported similar frequencies for both trial period and benchmark tests, vendors reported a higher frequency of benchmark procedures, regardless of whether the software was custom developed or packaged. No vendor in this sample reported experience with an independent verification and validation exercise by a third party.

Given the vendors' perception of the frequency of use of competitive bids, it is not surprising that vendors also feel the most frequent test of the software is a benchmark, either against criteria established by the agency or against competitive vendors. What may be surprising is the absence of vendors' reporting experience with trial periods. It may be the case that this testing method is becoming less frequently used than reported by the agencies. And, it is also likely that vendors are less willing to risk the effort required to install and deinstall software without tangible returns or without a sizeable opportunity waiting at the completion of a successful trial period.

E

Postimplementation Support and End-User Involvement

Exhibit V-11 indicates general agreement between the perceptions agencies have of vendors' reputations for support and the vendors' perceptions of the agencies' view. The ratings are consistently favorable for both groups, indicating that vendors are responsive to these agency needs and that agencies recognize the quality support they receive.

Variations between the two group do exist. Agencies seem to value changes in the product more than training or consulting about the product, whereas vendors reverse the importance. This phenomenon is

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EXHIBIT V-11

AGENCY VERSUS VENDOR RATINGS OF VENDOR REPUTATION FOR POSTIMPLEMENTATION SUPPORT

FACTOR	AVERAGE RATING*	
	AGENCY	VENDOR
Fixing Errors	4.5	4.5
Improve Features/Functions	4.0	3.8
Training	4.0	4.2
Extend Features/Functions	3.8	3.5
Add Features/Functions	3.8	3.9
Consulting	3.5	4.2

*Rating: 1 = Least Important; 5 = Very Important

entirely consistent with early analyses that indicated that vendors are inclined to support the client with service rather than with additional development.

F

Issues and Concerns

Vendors were queried on whether they were aware of any special agency requirements for operating system software. The requirements mentioned include: relational data bases, POSIX standards, communication standards, Ada interfaces, and computer security. However, additional products directed to these agency needs appear to be coming into the marketplace.

Agencies are also turning to the vendor community for software productivity generators and software development packages. Agencies are acquiring software productivity generators for building software, auto-

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mating systems, and reviewing and testing functions. Software development packages are employed for accessing data bases, artificial intelligence applications, screen generators, and automating productivity. Vendors interviewed noted a growing acceptance of these products in the federal arena through greater use in multiple-hardware environments.

Recently, PRC developed a technology for an advanced software process entitled Automatic Production Control Environment (APCE). After completing the development of APCE, PRC was awarded a $60 million share of Lockheed's $200 million contract to create the Software Support Environment for NASA's Space Station. The APCE software will be employed to build, maintain, and guarantee an error-free and self-correcting information system for NASA.

Industry respondents were also questioned as to whether any standards activities from either the government agencies or industry have had an impact on the federal software market. Exhibit V-12 lists the most frequently cited standards viewed as having a significant impact on the government's spending for software products and services. Military Standard 2167—which directs defense system software development, testing, documentation, and evaluation—was mentioned most frequently.

EXHIBIT V-12

VENDOR RANKING OF STANDARDS AFFECTING FUTURE GOVERNMENT SPENDING FOR SOFTWARE PRODUCTS AND SERVICES

FACTOR	RANK*
Mil Std 2167	1
OSI	2
TCP/IP	3
Ada	4
POSIX & GOSIP	5

* Rank based on frequency of mention by respondents.

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The other standards listed are those that are undergoing continued efforts by the National Bureau of Standards and industry representatives and will have far-reaching effects on the industry. Developments in these areas are particularly useful to software vendors and system integrators for developing capabilities to transfer software applications. Additional computer standards of growing concern to vendors include networking, image management, and computer security.

The government's budgetary constraints and budgetary policies are viewed by vendors as having a significant impact on the federal marketplace. Budget cuts and changes in authorization and appropriations have delayed and directly influenced agency software acquisitions. Respondents noted that agency procurements recently have favored commercially available software packages in response to budget constraints and agency policy. Furthermore, the need for agencies to justify customization of a software package when an off-the-shelf package fulfills 80% of the requirements is slowing the procurement of custom applications and systems software development in some agencies.

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Key Opportunities

This section describes specific opportunities in the federal information technology market. Lists of programs are provided for future software products and related services. The opportunities list consists of major programs that are typical of the federal market and serves as a representative sample.

The list of opportunities becomes smaller after fiscal year 1988 because new programs have not yet been identified or initially approved by the responsible agencies. Subsequent issues of this report and the INPUT *Procurement Analysis Reports* will include additional programs and detailed program information for fiscal years 1989 through 1992.

A

Present and Future Programs

Funding for software and related services is provided in several budget categories of federal government agencies.

- Software and equipment as a line item under capital investment do not include software bundled with hardware and software that is acquired on a lease basis.
- The programming and analysis item includes some packaged software that will be purchased to be modified or as a part of some larger program.
- The operations and maintenance item may include software maintenance as part of facilities management.

New information technology programs, including software and related services acquisitions that are larger than $1-2 million, are listed in at least one of the following federal government documents:

- OMB/GSA Five-Year Plan, which is developed from agency budget requests submitted in compliance with OMB Circular A-11.

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- Agency long-range information resource plans developed to meet the reporting requirements of the Paperwork Reduction Act of 1980.

- Agency annual operating budget requests submitted to both congressional oversight and appropriations committees based on the OMB A-11 information.

- Commerce Business Daily notice of specific opportunities—for qualification as a bidder and for requesting a copy of an RFP or RFQ.

- Five-Year Defense Plan, which is not publicly available, and the supporting documentation of the separate military departments and agencies.

- Classified program documentation available to qualified DoD contractors.

Software products and software development opportunities may or may not be specifically identified as such in these documents:

- Information technology planning documents usually identify mission requirements to be met by specific programs, rather than methods for meeting these requirements.

- Some mission requirements could be satisfied equally well by software products, custom software development, or a combination of both.

- Agencies have shown an increasing tendency to use integration contracts for larger, more complex systems. Software product and development requirements may be included in these contracts, rather than met through separate acquisitions by the agencies.

- To add to the difficulty of identifying planned software buys, most medium and smaller buys valued at less than $1 million are rarely identified in agency budget documents.

All funding proposals are based on cost data of the year submitted, with inflation factors dictated by the Administration as part of its fiscal policy, and are subject to revision, reduction, or spread to future years in response to Congressional direction. Some additional reductions will be likely in fiscal 1988 and beyond due to the deficit reduction constraints of the Gramm-Rudman-Hollings Act.

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B

Software and Related Services/ Opportunities by Agency

Agency/Program		Par Reference	Schedule	FY88-FY92 Funding ($M)
Air Force/AFCC	Project 6000	V-1-2	UNK	UNK
Air Force/MAC	MAC Command and Control (C2) Upgrade	V-1-6	UNK	UNK
Air Force/AFWAL	Mission Avionics Division Research ADPE	V-1-13	UNK	UNK
Air Force/ESD	Air Force WWMCCS Information System (AFWIS)	V-1-27	UNK	UNK
Air Force/ESD	WWMCCS Information System (WIS)	V-1-32	UNK	UNK
Air Force/ATC	Command Readiness Exercise System	V-1-34	2QFY89	$29.4
Air Force/AWS	Computer Replacement Enhancement at USAFETAC, DLA	V-1-74	2QFY88	UNK
Air Force/AFCAC	Standard Multiuser Small Computer Requirements Contract (SMSCRC)	V-1-83	11/87	$3-5
Air Force/AFGWC	Advanced Computer Flight Plan (ACFP)	V-1-93	1QFY90	$6.2
Air Force/MAC	MAC Information Processing	V-1-101	3/88	$116.7
Air Force/ESD	WIS Joint Mission Processor	V-1-103	UNK	$28.1
Air Force/AFLC	Contracting Data Management System - Phase II	V-1-104	1QFY89	$58.1
Air Force/MAC	Special Operations Forces Enhancement of the Automated Mission Planning System (AMPS)	V-1-105	FY88	UNK
Air Force/AFSC	Computer-Aided Acquisition and Logistics Support, (CALS)	V-1-108	UNK	$124.1

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Army/ISEC	Army World-Wide Military Command and Control System (WWMCCS) Information System (AWIS)	V-2-8	FY89	$15.0
Army/AMC	Standard Depot Systems (SDS)	V-2-28	2QFY89	$177.2
Army/ISEC	Army Corporate Data Base Project (ACDBP)	V-2-31	3QFY88	$74.4
Army/DTSW	Telecommunications Modernization Program (TEMPO)	V-2-32	1/88	UNK
Army/ISEC	Army Information Systems Integration Project (AISI)	V-2-33	UNK	UNK
Army/Reserves	Reserve Component Automation System, (RCAS)	V-2-34	2/88	$99.1
Army/AMC	Computer-Aided Acquisition and Logistic Support, (CALS)	V-2-35	UNK	$84.7
Navy/Comptroller	PERSPAY Consolidated Computer Center Program	V-3-11	1/91	$58.3
Navy/ FLENUMOCEANCEN	Primary Environmental Processing System Replacement (PEPSR)	V-3-22	FY89	$10.4
Navy/NMPC	Military Personnel - Navy (MPN) Financial System (MFS)	V-3-29	FY89	UNK
Navy/ NAVSUPSYSCOM	Computer-Aided Acquisition and Logistics Support, (CALS)	V-3-80	UNK	$274.4
Navy/SPAWAR	Navy World-Wide Military Command and Control System (WWMCCS) Information System (WIS)	V-3-83	6/89	$9.6
USMC	Marine Air Ground Task Force (MAGTF) Lift Model II	V-3A-8	UNK	$8.9
DLA	Computer-Aided Acquisition and Logistic Support, (CALS)	V-4A-14	UNK	$25.3
OSD/OASD	Computer-Aided Acquisition and Logistic Support, (CALS)	V-4E-4	UNK	$409.6

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USDA/FmHA	Automated Administrative Management System	VI-5-24	2/88	$5.7
USDA/FSIS	Inspection Position Coverage	VI-5-26	5/88	$1.5
DOC/NWS	Advanced Weather Interactive Processing System (AWIPS)	VI-6-24	2QFY89	$143.2
DOI/U.S. Fish and Wildlife Service	Service Support for the Western Energy and Land Use Term	VII-9-10	2/89	UNK
DOI/BLM	Automated Land and Mineral Record System (ALMRS)	VII-9-11	2QFY88	$89.4
DOJ/Tax Division	Litigation Support	VII-10-18	UNK	$8.8
DOJ/Federal Prison Industries	Standard Industries System	VII-10-19	2QFY89	$8.8
DOJ/US Marshals Service	National Prisoner Transportation System	VII-10-23	3QF88	$1.8
DOT/USCG	Aircraft Maintenance Information System	VII-11-19	UNK	UNK
DOT/FAA	Computer Resources Nucleus (CORN)	VII-11-28	UNK	$100.8
Treas/IRS	Automated Examination System	VII-12-5	4QFY88	$821.2
Treas/IRS	Information Systems Development	VII-12-6	3QFY89	$1,023.8
Treas/IRS	Treasury Multiuser Acquisition Contract (TMAC)	VII-12-12	UNK	UNK
Treas/USCS	Automated Commercial System	VII-12-51	UNK	$62.7
Treas/BFD	Data Administration	VII-12-54	UNK	$3.2
GSA	Multiple Award Schedule	VIII-14-3	UNK	$408.1
GSA	Office of Software Development and Information Technology	VIII-14-15	UNK	UNK
NASA/LCRC	Class VII Computer System	VIII-15-57	3QFY88	$20.0

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NASA/AMES	Numerical Aerodynamic Simulator (NAS) Processing System Network (NPSN) - Graphics Subsystem	VIII-15-59	2/1/88	$8.3
NASA/AMES	Numerical Aerodynamic Simulator (NAS) Processing System Network (NPSN) - Hi-Speed Processors #2, #3, and #4	VIII-15-60	FY90	$79.9
SEC	Electronic Data Gathering Analysis and Retrieval (EDGAR)	VIII-23-3	1QFY96	$45.9
AID/IRM	Upgrading Computer Services for the Central Computing Center	VIII-26-1	4QFY89	$2.6

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Appendix: Interview Profiles

A

Federal Agency Respondent Profile

1. Contract Summary

Agency contacts were made both by telephone and through on-site interviews.

For this update, the distribution of job classifications among individual agency respondents included the following:

- Policy makers
- Buyers
- Users

Also for this 1987 analysis, INPUT contacted agency contracting and program management officials for the major software product and development initiatives listed in Section VI of this report.

2. List of Agencies

Respondents to the 1987 update and the previous INPUT questionnaires represented the agencies listed below. The number in parentheses indicates the total number of different contacts within each agency.

- Civil agencies.

  - Agriculture (4)
  - Commerce (3)
  - Education (1)
  - EPA (1)
  - FCC (1)
  - FEMA (1)
  - GSA (3)
  - HHS (4)

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- HUD (2)
- Interior (2)
- Justice (3)
- Labor (1)
- NASA (5)
- NBS (3)
- NSF (1)
- OMB (1)
- State (1)
- Transportation (2)
- Treasury (2)

• Defense agencies.

- Air Force (5)
- Army (8)
- Navy (4)
- Other defense agencies (5)

B

Vendor Respondent Profile

The information services vendors interviewed during the course of this research represent a diversified group of vendors conducting software and related services business with the federal government. In some cases, the companies derive revenue from the federal government from both packaged software and custom-developed software, regardless of their most noted product/service offerings.

In addition, for this updated report, INPUT also conducted interviews with a representative sample of vendors that obtain federal revenues from software specifically related to supercomputers and artificial intelligence. All contacts with vendor personnel were made by telephone.

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B

Appendix: Definitions

The definitions in this appendix include hardware, software, services, and telecommunications categories to accommodate the range of information systems and services programs described in this report.

Alternate service mode terminology employed by the federal government in its procurement process is defined along with INPUT's regular terms of reference, as shown in Exhibit B-1.

The federal government's unique non-technical terminology that is associated with applications, documentation, budgets, authorization, and the procurement/acquisition process is included in Appendix C, Glossary.

A
Service Modes

1. Processing Services

Processing services include remote computing services, batch services, and processing facilities management.

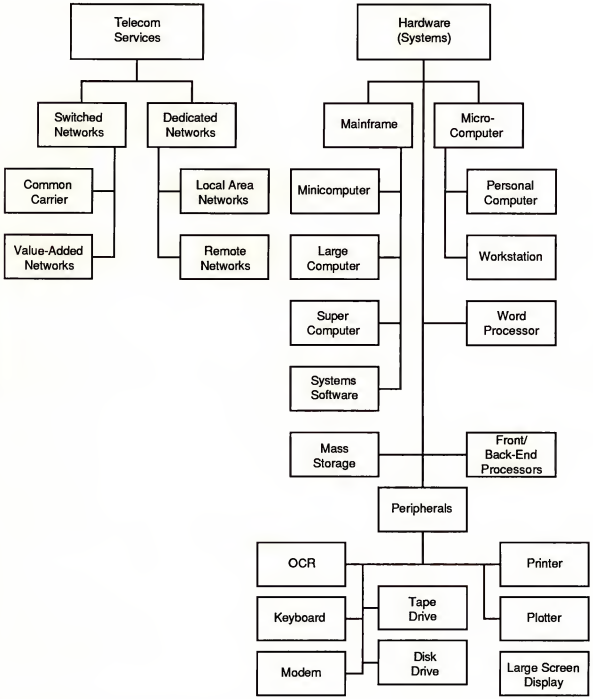
Remote Computing Services (RCS) - Provision of data processing to a user by means of terminals at the user's site(s). Terminals are connected by a data communications network to the vendor's central computer. The most frequent contract vehicle for RCS in the federal government is GSA's Teleprocessing Services Program (TSP). RCS includes the following submodes.

- *Interactive (timesharing)* - Characterized by the interaction of the user with the system, primarily for problem-solving timesharing but also for data entry and transaction processing; the user is on-line to the program/files.
- *Remote Batch* - Where the user hands over control of a job to the vendor's computer which schedules job execution according to priorities and resource requirements.

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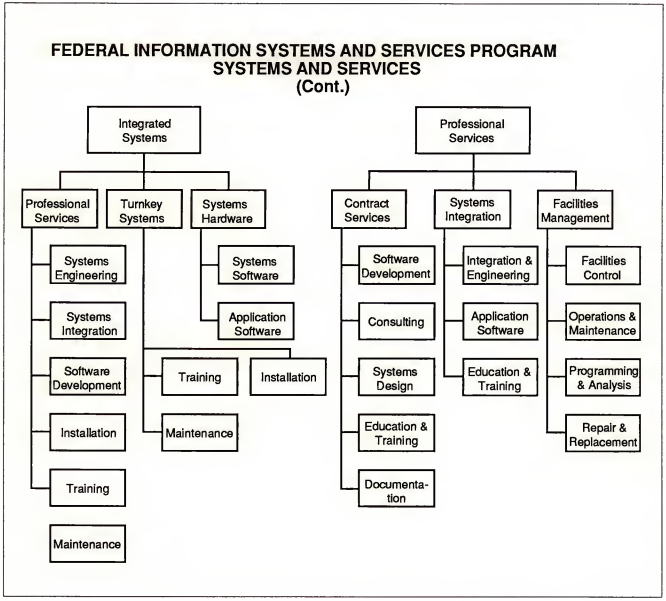
EXHIBIT B-1a

FEDERAL INFORMATION SYSTEMS AND SERVICES PROGRAM SYSTEMS AND SERVICES



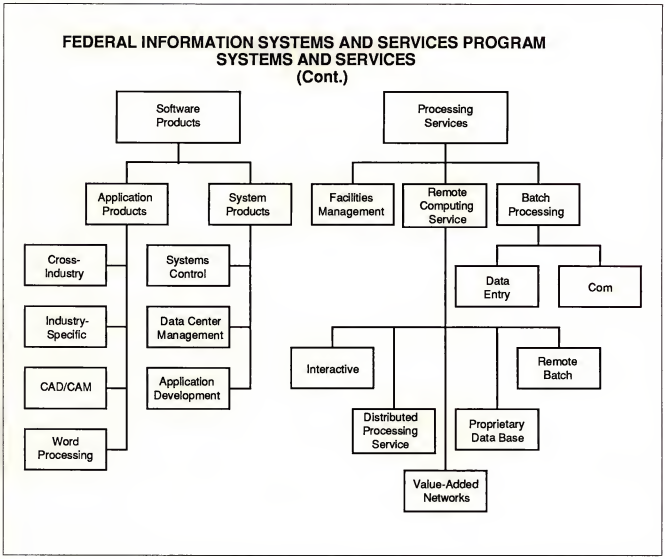
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EXHIBIT B-1b



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EXHIBIT B-1c



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- *Proprietary Data Base* - Characterized by the retrieval and processing of information from a vendor-maintained data base. The data base may be owned by the vendor or by a third party or be licensed by a federal agency.

- *Value-Added Network Services* - Special purpose and/or high-quality network specifically designed to carry digital information, with features not usually provided by the voice-grade, switched public network.

- *Distributed Processing Services* - Alternately called "Distributed Data Processing" (DDP) that can provide:

  - Access through the network to the RCS vendor's larger computers.

  - Local management and storage of a data base subset that will service local terminal users via the connection of a data base processor to the network.

  - Availability of significant software that may be "down loaded" as part of the service.

Batch Processing - These include data processing performed at vendors' sites for user programs and/or data that are physically transported (as opposed to transported electronically by telecommunications media) to and/or from those sites. Data entry and data output services, such as keypunching and computer output microfilm processing, are also included. Batch services include expenditures by users who take their data to a vendor site that has a terminal connected to a remote computer for the actual processing.

Processing Facilities Management (PFM) - Also referred to as "Resource Management," "Systems Management," or "COCO" (Contractor-Owned, Contractor-Operated). The management of all or part of a user's data processing functions under a long-term contract of not less than one year. This would include remote computing and batch services. To qualify as PFM, the contractor must directly plan, control, operate, and own or lease the facility provided to the user, either on-site, through communications lines, or in a mixed mode.

2. Professional Services

Professional services provide labor-intensive consulting, design, education and training, programming and analysis, management, and systems integrations as defined within these general categories.

- *Contract Services* - Provision of professional and technical services of various skill levels to accomplish specific tasks not specifically or necessarily associated with a delivered product, other than paper or

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ADP media records. Contracts generally require vendor management of staff and/or resources.

- *Consulting* - Information systems and/or services management consulting, program assistance (technical and/or management), feasibility analyses, and cost-effectiveness trade-off studies.

- *Education and Training* - Products and/or services related to information systems and services for the user, including computer-aided instruction (CAI), computer-based education (CBE), and vendor instruction of user personnel in management operations, programming, and maintenance of systems.

- *Systems Design* - Preparation of systems/sub-systems architecture, specifications, and performance criteria from functional information processing statements or performance of an operations requirements study. May include ADP, telecommunications, site layout, training, and maintenance facilities.

- *Software Development* - Also known as programming and analysis services, this includes applications and systems software design, contract or custom programming, code conversion, independent verification and validation (IV&V), and benchmarking. These services may also include follow-on software development and maintenance.

- *Documentation Services* - Vendor preparation, modification, or replacement of system operating manuals, software coding records, training manuals, software library records, and equipment modification records.

Professional Services Facilities Management (PSFM) - Also referred to as GOCO (Government-Owned, Contractor-Operated) services. The computing equipment is owned or leased by the client (government), not by the vendor. The vendor provides the staff to operate, maintain, repair, schedule, and manage the client's facility over a term of three to five years. Submodes include:

- *Facilities Control* - Vendor management, including scheduling of resources and personnel, to meet specified operations objectives or produce specified information products, with no direct client supervision.

- *Operation and Maintenance (O&M)* - Vendor operation and maintenance of government-owned ADP/telecommunications equipment in a government-owned/leased facility (on-site) without vendor management of the facility.

- *Programming and Analysis (Support)* - Vendor-furnished professional and technical staff support, which may be provided on or off the client's

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site, to analyze information processing requirements, plan resource applications, and/or develop/modify/maintain custom software, over a period of time not less than one year. Contracts tend to be task-oriented to control the work flow.

- *Hardware and/or Software Maintenance* - Vendor-furnished services provided after installation and acceptance by the government, where the vendor may not be the original supplier (third-party maintenance or TPM) and may use either on-site or on-call personnel to perform services.

- *Repair and Replacement* - Vendor-furnished services and acquires information system components to repair or replace worn or defective equipment and to add equipment needed to meet new or unusual requirements.

Systems Integration - Services associated with design and integration, software development, and installation and government acceptance of ADP/telecommunications systems. Services may also include related engineering activities such as Systems Engineering and Integration (SE&I) or Systems Engineering and Technical Assistance (SETA).

- *Engineering and Integration* - Vendor-furnished technical services provided separately from acquisition of hardware and software to expand the initial design into specifications, interface descriptions, installation, and operating instructions of the complete system.

- *Applications Software* - Custom software development to satisfy noncommercially available information processing requirements of an integrated system.

- *Education and Training* - Vendor development of training aids, manuals, and curricula for indoctrinating client management, operation and maintenance, and information product user personnel on the newly integrated information system.

3. Turnkey Systems

Turnkey systems, also known as integrated systems, include systems and applications software packaged with hardware as a single entity. Most CAD/CAM systems and many small business systems are integrated systems. This mode does not include specialized hardware systems such as word processors, cash registers, and process control systems.

4. Software Products

Software products include user purchases of applications and systems packages for in-house computer systems. Included are lease and pur-

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chase expenditures, as well as expenditures for work performed by the vendor to implement and maintain the package at the user's sites. Expenditures for work performed by organizations other than the package vendor are counted in the category of professional services. There are several subcategories of software products, as indicated below and shown in detail in Exhibit B-2.

Application Products - Software that performs processing which services user functions. The products can be:

- *Cross-Industry Products* - Used in multiple industry applications as well as in federal government sectors. Examples are payroll, inventory control, and financial planning.

- *Industry-Specialized Products* - Used in a specific federal government sector, such as planning, resource utilization, aircraft flight planning, military personnel training, and others. May also include some products designed to work in an industry other than the federal government but applicable to specific government-performed commercial/industrial services, such as hospital information, vehicular fleet scheduling, electrical power generation and distribution, CAD/CAM, and others.

Systems Products - Software that enables the computer/communications systems to perform basic functions. These products include:

- *System Control Products* - Function during applications program execution to manage the computer system resources. Examples include operating systems, communication monitors, emulators, and spoolers.

- *Data Center Management Products* - Used by operations personnel to manage the computer systems resources and personnel more effectively. Examples include performance measurement, job accounting, computer operations scheduling, and utilities.

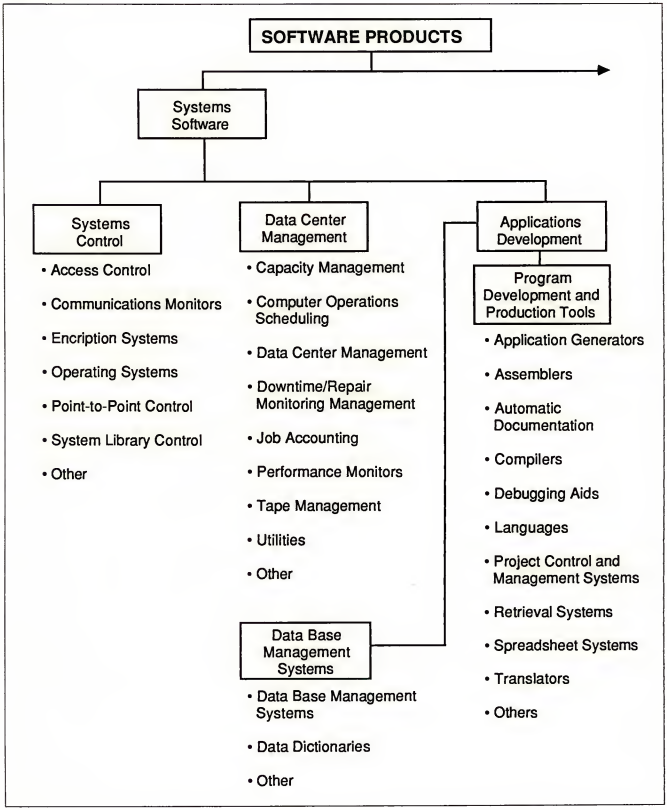
- *Applications Development Products* - Used to prepare applications for execution by assisting in designing, programming, testing, and related functions. Examples include languages, sorts, productivity aids, compilers, data dictionaries, data base management systems, report writers, project control systems, and retrieval systems.

5. Hardware and Hardware Systems

Hardware included all ADP and telecommunications equipment that can be separately acquired by the government with or without installation by the vendor and not acquired as part of an integrated system. For the purpose of this report, hardware is grouped in three major categories: peripherals, terminals, and hardware systems (processors).

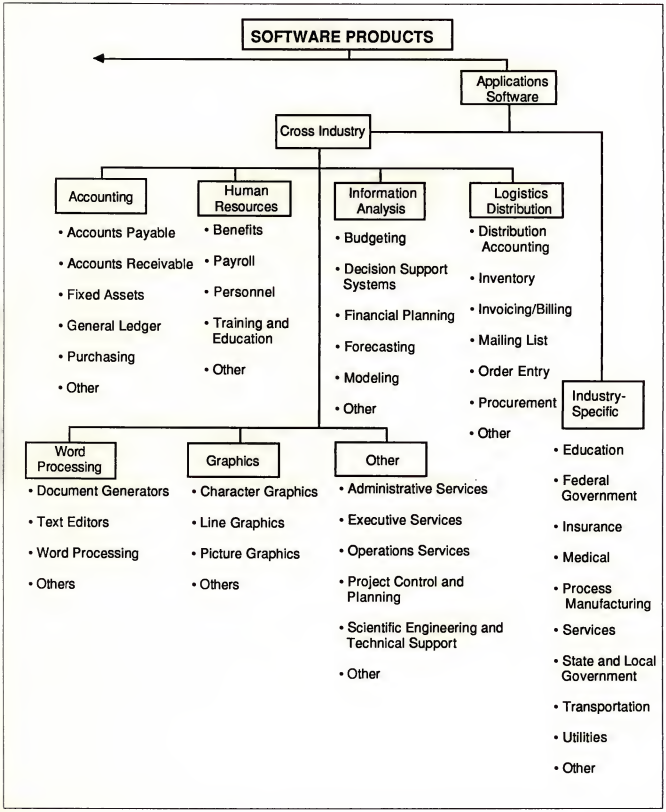
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EXHIBIT B-2a



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EXHIBIT B-2b



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Peripherals - Include all input, output, communications, and storage devices other than main memory that can be connected locally to the main processor and generally cannot be included in other categories such as terminals.

- *Input Devices* - Includes keyboards, numeric pads, card readers, light pens and track balls, tape readers, position and motion sensors, and analog-to-digital converters.

- *Output Devices* - Includes printers, CRTs, projection television screens, micrographics processors, digital graphics, and plotters.

- *Communication Devices* - Modems, encryption equipment, special interfaces, and error control.

- *Storage Devices* - Includes magnetic tape (reel, cartridge, and cassette), floppy and hard disks, drums, solid state (integrated circuits), and bubble and optical memories.

Terminals - Federal government systems use three types of terminals as described below.

- *User-Programmable* - Also called intelligent terminals, including:

  - Single-station or standalone.
  - Multi-station shared processor.
  - Teleprinter.
  - Remote batch.

- *Non-Programmable* - Also called "dumb" terminals, including:

  - Single-station.
  - Multi-station shared processor.
  - Teleprinter.

- *Limited Function* - Originally developed for specific needs, such as point-of-sale (POS), inventory data collections, controlled access, and other applications.

Hardware Systems - Includes all processors from microcomputers to supercomputers. Hardware systems may require type- or model-unique operating software to be functional, but this category excludes applications software and peripheral devices, other than main memory and processors or CPUs not provided as part of an integrated (turnkey) system.

- *Microcomputer* - Combines all of the CPU, memory, and peripheral functions of an 8-, 16-, or 32-bit computer on a chip in the form of:

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- Integrated circuit package.

- Plug-in boards with more memory and peripheral circuits.

- Console including keyboard and interfacing connectors.

- Personal computer with at least one external storage device directly addressable by the CPU.

- An embedded computer which may take a number of shapes or configurations.

- *Minicomputer* - Usually a 12-, 16-, or 32-bit computer which may be provided with limited applications software and support and may represent a portion of a complete large system.

  - Personal business computer.
  - Small laboratory computer.
  - Nodal computer in a distributed data network, remote data collection network, or connected to remote microcomputers.

- *Midicomputer* - Typically a 32- or 64-bit computer with extensive applications software and a number of peripherals in standalone or multiple-CPU configurations for business (administrative, personnel, and logistics) applications; also called a general purpose computer.

- *Large Computer* - Presently centered around storage controllers but likely to become bus-oriented and to consist of multiple processors or parallel processors. Intended for structured mathematical and signal processing and typically used with general purpose, VonNeumann-type processors for system control.

- *Supercomputer* - High-powered processors with numerical processing throughput that is significantly greater than the fastest general purpose computers, with capacities in the 10-50 million floating point operations per second (MFLOPS) range. Newer supercomputers, with burst modes approaching 300 MFLOPS, main storage size up to 10 million words, and on-line storage in the one-to-three gigabyte class, are labeled Class IV to Class VII in agency long-range plans. Supercomputers fit in one of two categories:

  - *Real Time* - Generally used for signal processing in military applications.

  - *Non-Real Time* - For scientific use in one of three configurations:

    - Parallel processors.
    - Pipeline processor.
    - Vector processor.

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- *Super( )computer* - Term applied to micro, mini, and large mainframe computers with performance substantially higher than attainable by VonNeuman architectures.

- *Embedded Computer* - Dedicated computer system designed and implemented as an integral part of a weapon, weapon system, or platform; critical to a military or intelligence mission such as command and control, cryptological activities, or intelligence activities. Characterized by military specifications (MIL SPEC) appearance and operation, limited but reprogrammable applications software, and permanent or semi-permanent interfaces. May vary in capacity from microcomputers to parallel processors computer systems.

6. Telecommunications

Networks - Electronic interconnections between sites or locations which may incorporate links between central computer sites and remote locations and switching and/or regional data processing nodes. Network services typically are provided on a leased basis by a vendor to move data, voice, video, or textual information between locations. Networks can be categorized in several different ways.

- *Common Carrier Network* - A public access network, such as provided by AT&T, consisting of conventional voice-grade circuits and regular switching facilities accessed through dial-up calling with leased or user-owned modems for transfer rates between 150 and 1,200 baud.

- *Value-Added Network (VAN)* - Provided by vendors through common carrier or special-purpose transmission facilities with special features not available in the voice-grade switched public network. These include:

  - *Dedicated Network* - Also known as a private network, established and operated for one user or user organization using dedicated circuits to establish permanent connections between two or more stations.

  - *Packet Switching* - Real time network routing, transmitting, and receiving data in the form of addressed packets, each of which may be part of a message or include several messages without exclusive use of a network circuit by the transmitting and receiving stations.

  - *Message Switching* - Non-real time process for routing messages through network where a user message is received, stored, and forwarded from switch to switch through the network without an end-to-end circuit between sending and receiving stations; used primarily for data.

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- *Local Area Network (LAN)* - Limited-access network between computing resources in a relatively small (but not necessarily contiguous) area, such as a building, complex of buildings, or buildings distributed within a metropolitan area. Uses one of two signalling methods.

  - *Baseband* - Signaling using digital waveforms on a single frequency band, usually at voice frequencies, and bandwidth, limited to a single sender at any given moment. When used for local area networks, typically implemented with TDM to permit multiple access.

  - *Broadband* - Transmission facilities that use frequencies greater than normal voice-grade, supported in local area networks with RF modems and AC signaling. Also known as wideband. Employs multiplexing techniques that increase carrier frequency between terminals to provide:

    - Multiple channels through FDM or TDM.
    - High-speed data transfer via parallel mode at rates of up to 96,000 baud.

Transmission Facilities - Includes wire, carrier, coaxial cable, microwave, optical fiber, satellites, cellular radio, and marine cable operating in one of two modes depending on the vendor and the distribution of the network.

- *Mode* - may be either:

  - *Analog* - Transmission or signal with continuous waveform representation, typified by AT&T's predominantly voice-grade DDD network and most telephone operating company distribution systems.

  - *Digital* - Transmission or signal using discontinuous, discrete quantities to represent data, which may be voice, data, record, video, or text, in binary form.

- *Media* - May be any of the following:

  - *Wire* - Varies from earlier single-line teletype networks, to two-wire standard telephone (twisted pair), to four-wire full-duplex balanced lines.

  - *Carrier* - A wave, pulse train, or other signal suitable for modulation by an information-bearing signal to be transmitted over a communications system, used in multiplexing applications to increase network capacity.

  - *Coaxial Cable* - A cable consisting of an insulated central conductor surrounded by a cylindrical conductor with additional insulation on

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the outside and covered with an outer sheath used in HF (high frequency) and VHF (very high frequency), single frequency, or carrier-based systems; requires frequent reamplification (repeaters) to carry the signal any distance.

- *Microwave* - UHF (ultra-high frequency) multi-channel, point-to-point, repeated radio transmission, also capable of wide frequency channels.

- *Optical Fiber* - Local signal distribution systems employed in limited areas, using light-transmitting glass fibers and TDM for multi-channel applications.

- *Communications Satellites* - Synchronous earth-orbiting systems that provide point-to-point, two-way service over significant distances without intermediate amplification (repeaters), but requiring suitable groundstation facilities for up- and down-link operation.

- *Cellular Radio* - Network of fixed, low-powered two-way radios that are linked by a computer system to track mobile phone-data set units. Each radio serves a small area called a cell. The computer switches service connection to the mobile unit from cell to cell.

B

General Definitions

103/113 - Bell standard modem for low-speed transmission up to 300 bps, asynchronous, half or full duplex.

212 - Bell standard for medium-speed transmission at 1200 bps, asynchronous or synchronous, half or full duplex.

ASCII - American National Standard Code for Information Interchang—eight-bit code with seven data bits and one parity bit.

Asynchronous - Communications operation (such as transmission) without continuous timing signals. Synchronization is accomplished by appending signal elements to the data.

Bandwidth - Range of transmission frequencies that can be carried on a communications path; used as a measure of capacity.

Baud - Number of signal events (discrete conditions) per second. Typically used to measure modem or terminal transmission speed.

Benchmark - Method of testing proposed ADP system solutions for a specified set of functions (applications) employing simulated or real data inputs under simulated operating conditions.

BPS - Bits per second - also mbps and kbps, million bits per second and thousand bits per second, respectively.

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BSC - IBM's binary synchronous communications data link protocol. First introduced in 1968 for use on point-to-point and multipoint communications channels. Frequently referenced as "bisync."

Byte - Usually equivalent to the storage required for one alphanumeric character (i.e., one letter or number).

CBX - Computerized Branch Exchange - a PABX based on a computer system, implying programmability and usually voice and data capabilities.

Central Processing Unit (CPU) - The arithmetic and control portion of a computer; i.e., the circuits controlling the interpretation and execution of computer instructions.

Centrex - Central office telephone services that permit local circuit switching without installation of customer premises equipment. Could be described as shared PBX service.

Circuit Switching - A process that, usually on demand, connects two or more network stations and permits exclusive circuit use until the connection is released; typical of the voice telephone network where a circuit is established between the caller and the called party.

CO - Central Office - local telco site for one or more exchanges.

CODEC - Coder/decoder, equivalent to modem for digital devices.

Constant Dollars - Growth forecasts in constant dollars make no allowance for inflation or recession. Dollar value based on the year of the forecast unless otherwise indicated.

Computer System - The combination of computing resources required to perform the designed functions and which may include one or more CPUs, machine room peripherals, storage systems, and/or applications software.

CPE - Customer Premises Equipment - DCE or DTE located at a customer site rather than at a carrier site such as the local telephone company CO. May include switchboards, PBX, data terminals, and telephone answering devices.

CSMA/CD - Carrier Sense Multiple Access/Collision Detect. Contention protocol used in local-area networks, typically with a multi-point configuration.

Current Dollars - Estimates or values expressed in current-year dollars which, for forecasts, would include an allowance for inflation.

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Data Encryption Standard (DES) - 56-bit key, one-way encryption algorithm adopted by NBS in 1977, implemented through hardware ("S-boxes") or software. Designed by IBM with NSA guidance.

Datagram - A self-contained packet of information with a finite length that does not depend on the contents of preceding or following packets.

DCA - IBM's Document Content Architecture - protocols for specifying document (text) format which are consistent across a variety of hardware and software systems within IBM's DISOSS.

DCE - Data Circuit-terminating Equipment - interface hardware that couples DTE to a transmission circuit or channel by providing functions to establish, maintain, and terminate a connection, including signal conversion and coding.

DDCMP - Digital Data Communications Message Protocol - data link protocol used in Digital Equipment Company's DECNET.

DECNET - Digital Equipment Company's network architecture.

Dedicated Circuit - A permanently established network connection between two or more stations; contrast with switched circuit.

DEMS - Digital Electronic Message Service - nationwide common carrier digital networks which provide high-speed, end-to-end, two-way transmission of digitally-encoded information using the 10.6 GHz band.

DIA - IBM's Document Interchange Architecture - protocols for transfer of documents (text) between different hardware and software systems within IBM's DISOSS.

DISOSS - IBM's DIStributed Office Support System - office automation environment, based on DCA and DIA, which permits document (text) transfer between different hardware and software systems without requiring subsequent format or content revision.

Distributed Data Processing - The development of programmable intelligence in order to perform a data processing function where it can be accomplished most effectively through computers and terminals arranged in a telecommunications network adapted to the user's characteristics.

DTE - Data Terminal Equipment - hardware which is a data source or sink or both, such as video display terminals that convert user information into data for transmission and reconvert data signals into user information.

EBCDIC - Extended Binary Coded Decimal Interchange Code - eight-bit code typically used in IBM mainframe environments.

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EFT - Electronic funds transfer.

Encryption - Electrical, code-based conversion of transmitted data to provide security and/or privacy of data between authorized access points.

End User - One who is using a product or service to accomplish his or her own functions. The end user may buy a system from the hardware supplier(s) and do his or her own programming, interfacing, and installation. Alternately, the end user may buy a turnkey system from a systems house or hardware integrator, or may buy a service from an in-house department or external vendor.

Engineering Change Notice (ECN) - Product changes to improve the product after it has been released to production.

Engineering Change Order (ECO) - The follow-up to ECNs - they include parts and a bill of materials to effect the change in the hardware.

Equipment Operators - Individuals operating computer control consoles and/or peripheral equipment (BLS definition).

Ethernet - Local area network developed by Xerox PARC using baseband signaling, CSMA/CD protocol, and coaxial cable to achieve a 10 mbps data rate.

Facsimile - Transmission and reception of data in graphic form, usually fixed images of documents, through scanning and conversion of a picture signal.

FDM - Frequency Division Multiplexing - a multiplexing method that permits multiple access by assigning different frequencies of the available bandwidth to different channels.

FEP - Front-End Processor - communications concentrator such as the IBM 3725 or COMTEN 3690 used to interface communications lines to host computers.

Field Engineer (FE) - Field engineer, customer engineer, serviceperson, and maintenance person are used interchangeably and refer to the individual who responds to a user's service call to repair a device or system.

Full-Duplex - Bi-directional communications with simultaneous two-way transmission.

General Purpose Computer System - A computer designed to handle a wide variety of problems. Includes machine room peripherals, systems software, and small business systems.

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Half-Duplex - Bi-directional communications, but only in one direction at a time.

Hardware Integrator - Develops system interface electronics and controllers for the CPU, sensors, peripherals, and all other ancillary hardware components. The hardware integrator also may develop control system software in addition to installing the entire system at the end-user site.

HDLC - High-level Data Link Control.

Hertz - Number of signal oscillations (cycles) per second - abbreviated Hz.

IBM Token Ring - IBM's local area network using baseband signalling and operating at 4 mbps on twisted-pair copper wire. Actually a combination of star and ring topologies – IEEE 802.5-compatible.

IDN - Integrated Digital Network - digital switching and transmission; part of the evolution to ISDN.

Independent Suppliers - Suppliers of machine room peripherals - usually do not supply general purpose computer systems.

Information Processing - Data processing as a whole, including use of business and scientific computers.

Installed Base - Cumulative number or value (cost when new) of computers in use.

Interconnection - Physical linkage between devices on a network.

Interoperability - The capability to operate with other devices on a network. To be contrasted with interconnection, which merely guarantees a physical network interface.

ISDN - Integrated Services Digital Network - integrated voice and non-voice public network service which is completely digital. Not clearly defined through any existing standards although FCC and other federal agencies are participating in the development of CCITT recommendations.

Keypunch Operators - Individuals operating keypunch machines (similar in operation to electric typewriters) to transcribe data from source materials onto punch cards.

Lease Line - Permanent connection between two network stations. Also known as dedicated or non-switched line.

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Machine Repairers - Individuals who install and periodically service computer systems.

Machine Room Peripherals - Peripheral equipment that is generally located close to the central processing unit.

Mainframe - The central processing unit (CPU or units in a parallel processor) of a computer that interprets and executes computer (software) instructions of 32 bits or more.

MAP - Manufacturing Automation Protocol - seven-layer communications standard for factory environments promoted by General Motors/EDS. Adopts IEEE 802.2 and IEEE 802.4 standards plus OSI protocols for other layers of the architecture.

Mean Time to Repair - The mean of elapsed times from the arrival of the field engineer on the user's site until the device is repaired and returned to user service.

Mean Time to Respond - The mean of elapsed times from the user call for services and the arrival of the field engineer on the user's site.

Message - A communication intended to be read by a person. The quality of the received document need not be high, only readable. Graphic materials are not included.

MMFS - Manufacturing Messaging Format Standard - application-level protocol included within MAP.

Modem - A device that encodes information into electronically transmittable from (MOdulator) and restores it to original analog form (DEModulator).

NCP - Network Control Program - software used in IBM 3705/3725 FEPs for control of SNA networks.

Node - Connection point of three or more independent transmission points which may provide switching or data collection.

Off-Line - Pertaining to equipment or devices that can function without direct control of the central processing unit.

On-Line - Pertaining to equipment or devices under direct control of the central processing unit.

OSI - ISO reference model for Open Systems Interconnection - seven-layer architecture for application, presentation, session, transport, network, data link, and physical services and equipment.

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OSI Application Layer - Layer 7, providing end-user applications services for data processing.

OSI Data Link Layer - Layer 2, providing transmission protocols, including frame management, link flow control, and link initiation/release.

OSI Network Layer - Layer 3, providing call establishment and clearing control through the network nodes.

OSI Physical Layer - Layer 1, providing the mechanical, electrical, functional, and procedural characteristics to establish, maintain, and release physical connections to the network.

OSI Presentation Layer - Layer 6, providing data formats and information such as data translation, data encoding/decoding, and command translation.

OSI Session Layer - Layer 5, establishes, maintains, and terminates logical connections for the transfer of data between processes.

OSI Transport Layer - Layer 4, providing end-to-end terminal control signals such as acknowledgements.

Overseas - Not within the geographical limits of the continental United States, Alaska, Hawaii, and U.S. possessions.

PABX - Private Automated Branch Exchange - hardware that provides automatic (electro-mechanical or electronic) local circuit switching on a customer's premises.

PAD - Packet Assembler-Disassembler - a device that enables DTE not equipped for packet switching operation to operate on a packet switched network.

PBX - Private Branch Exchange - hardware which provides local circuit switching on the customer premise.

PCM - Pulse-Code Modulation - modulation involving conversion of a waveform from analog to digital form through coding.

PDN - Public Data Network - a network established and operated by a recognized private operating agency, a telecommunications administration, or other agency for the specific purpose of providing data transmission services to the public.

Peripherals - Any unit of input/output equipment in a computer system, exclusive of the central processing unit.

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PPM - Pulse Position Modulation.

Private Network - A network established and operated for one user or user organization.

Programmers - Persons mainly involved in designing, writing, and testing of computer software programs.

Protocols - The rules for communication system operation that must be followed if communication is to be effected. Protocols may govern portions of a network or service. In digital networks, protocols are digitally encoded as instructions to computerized equipment.

Public Network - A network established and operated for more than one user with shared access, usually available on a subscription basis. See related international definition of PDN.

Scientific Computer System - A computer system designed to process structured mathematics, such as Fast Fourier Transforms, and complex, highly redundant information, such as seismic data, sonar data, and radar, with large on-line memories and very high capacity throughput.

SDLC - Synchronous Data Link Control - IBM's data link control for SNA. Supports a subset of HDLC modes.

SDN - Software-Defined Network.

Security - Physical, electrical, and computer (digital) coding procedures to protect the contents of computer files and data transmission from inadvertent or unauthorized disclosure to meet the requirements of the Privacy Act and national classified information regulations.

Service Delivery Point - The location of the physical interface between a network and customer/user equipment.

Simplex - Undirectional communications.

Smart Box - A device for adapting existing DTE to new network standards such as OSI. Includes PADs and protocol convertors, for example.

SNA - Systems Network Architecture-seven-layer communications architecture designed by IBM. Layers correspond roughly but not exactly to OSI model.

Software - Computer programs.

Supplies - Includes materials associated with the use or operations of computer systems, such as printer paper, keypunch cards, disk packs, and tapes.

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Switched Circuit - Temporary connection between two network stations established through dial-up procedures.

Synchronous - Communications operation with separate, continuous clocking at both sending and receiving stations.

Systems Analyst - Individual who analyzes problems to be converted to a programmable form for application to computer systems.

Systems House - Vendor that acquires, assembles, and integrates hardware and software into a total turnkey system to satisfy the data processing requirements of an end user. The vendor also may develop systems software products for license to end users. The systems house vendor does not manufacture mainframes.

Systems Integrator - Systems house vendor that develops systems interface electronics, applications software, and controllers for the CPU, peripherals, and ancillary subsystems that may have been provided by a contractor or the government (GFE). This vendor may either supervise or perform the installation and testing of the completed system.

TI - Bell System designation for 1.544 mbps carrier capable of handling 24 PCM voice channels.

TDM - Time Division Multiplexing - a multiplexing method that interleaves multiple transmissions on a single circuit by assigning a different time slot to each channel.

Token Passing - Local area network protocol which allows a station to transmit only when it has the "token," an empty slot on the carrier.

TOP - Technical Office Protocol - protocol developed by Boeing Computer Services to support administrative and office operations as complementary functions to factory automation implemented under MAP.

Turnkey System - System composed of hardware and software integrated into a total system designed to completely fulfill the processing requirements of a single application.

Twisted-Pair Cable - Communications cabling consisting of pairs of single-strand metallic electrical conductors, such as copper wires, typically used in building telephone wiring and some LANs.

Verification and Validation - Process for examining and testing applications and special systems software to verify that it operates on the target CPU and performs all of the functions specified by the user.

Voice-Grade - Circuit or signal in the 300-3300 Hz bandwidth typical of the public telephone system - nominally a 4 KHz user.

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VTAM - Virtual Telecommunications Access Method - host-resident communications software for SNA networks.

C

Other Considerations

When questions arise as to the proper place to count certain user expenditures, INPUT addresses the questions from the user viewpoint. Expenditures then are categorized according to what the users perceive they are buying.

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Appendix: Glossary of Federal Acronyms

The federal government's procurement language uses a combination of acronyms, phrases, and words that is complicated by different agency definitions and interpretations. The government also uses terms of accounting, business, economics, engineering, and law with new applications and technology.

Acronyms and contract terms that INPUT encountered most often in program documentation and interviews for this report are included here, but this glossary should not be considered all-inclusive. Federal procurement regulations (DAR, FPR, FAR, FIRMR, FPMR) and contract terms listed in RFIs, RFPs, and RFQs provide applicable terms and definitions.

Federal agency acronyms have been included to the extent they are employed in this report.

A

Acronyms

AAS	Automatic Addressing System.
AATMS	Advanced Air Traffic Management System.
ACO	Administrative Contracting Offices (DCAS).
ACS	Advanced Communications Satellite (formerly NASA 30/20 GHz Satellite Program).
ACT-1	Advanced Computer Techniques (Air Force).
Ada	DoD High-Order Language.
ADA	Airborne Data Acquisition.
ADL	Authorized Data List.
ADS	Automatic Digital Switches (DCS).
AFA	Air Force Association.
AFCEA	Armed Forces Communications Electronics Association.
AGE	Aerospace Ground Equipment.
AIP	Array Information Processing.
AMPE	Automated Message Processing Equipment.

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AMPS	Automated Message Processing System.
AMSL	Acquisition Management Systems List.
AP(P)	Advance Procurement Plan.
Appropriation	Congressionally approved funding for authorized programs and activities of the Executive Branch.
APR	Agency Procurement Request.
ARPANET	DARPA network of scientific computers.
ATLAS	Abbreviated Test Language for All Systems (for ATE-Automated Test Equipment).
Authorization	In the legislative process programs, staffing, and other routine activities must be approved by Oversight Committees before the Appropriations Committee will approve the money from the budget.
AUSA	Association of the U.S. Army.
AUTODIN	AUTOmatic DIgital Network of the Defense Communications System.
AUTOVON	AUTOmatic VOice Network of the Defense Communications System.
BA	Basic Agreement.
BAFO	Best And Final Offer.
Base level	Procurement, purchasing, and contracting at the military installation level.
BCA	Board of Contract Appeals.
Benchmark	Method of evaluating ability of a candidate computer system to meet user requirements.
Bid protest	Objection (in writing, before or after contract award) to some aspect of a solicitation by a valid bidder.
BML	Bidders Mailing List - qualified vendor information filed annually with federal agencies to automatically receive RFPs and RFQs in areas of claimed competence.
BOA	Basic Ordering Agreement.
B&P	Bid and Proposal - vendor activities in response to government solicitation/specific overhead allowance.
BPA	Blanked Purchase Agreement.
Budget	Federal Budget, proposed by the President and subject to Congressional review.
C2	Command and Control.
C3	Command, Control, and Communications.
C4	Command, Control, Communications, and Computers.
C3I	Command, Control, Communications, and Intelligence.
CAB	Contract Adjustment Board or Contract Appeals Board.
CADE	Computer-Aided Design and Engineering.
CADS	Computer-Assisted Display Systems.
CAIS	Computer-Assisted Instruction System.
CAPS	Command Automation Procurement Systems.
CAS	Contract Administration Services or Cost Accounting Standards.
CASB	Cost Accounting Standards Board.
CASP	Computer-Assisted Search Planning.
CBD	Commerce Business Daily - U.S. Department of Commerce publication

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	listing government contract opportunities and awards.
CBO	Congressional Budget Office.
CCDR	Contractor Cost Data Reporting.
CCN	Contract Change Notice.
CCPDS	Command Center Processing and Display Systems.
CCPO	Central Civilian Personnel Office.
CCTC	Command and Control Technical Center (JCS).
CDR	Critical Design Review.
CDRL	Contractor Data Requirement List.
CFE	Contractor-Furnished Equipment.
CFR	Code of Federal Regulations.
CIG	Computerized Interactive Graphics.
CIR	Cost Information Reports.
CM	Configuration Management.
CMI	Computer-Managed Instruction.
CNI	Communications, Navigation, and Identification.
CO	Contracting Office, Contract Offices, or Change Order.
COC	Certificate of Competency (administered by the Small Business Administration).
COCO	Contractor-Owned, Contractor-Operated.
CODSIA	Council of Defense and Space Industry Associations.
COMSTAT	Communications Satellite Corporation.
CONUS	CONtinental United States.
COP	Capability Objective Package.
COTR	Contracting Officer's Technical Representative.
CP	Communications Processor.
CPAF	Cost-Plus-Award-Fee Contract.
CPFF	Cost-Plus-Fixed-Fee Contract.
CPIF	Cost-Plus-Incentive-Fee Contract.
CPR	Cost Performance Reports.
CPSR	Contractor Procurement System Review.
CR	Cost Reimbursement (Cost Plus Contract).
CSA	Combat or Computer Systems Architecture.
C/SCSC	Cost/Schedule Control System Criteria (also called "C-Spec").
CWAS	Contractor Weighted Average Share in Cost Risk.
DAL	Data Accession List.
DAR	Defense Acquisition Regulations.
DARPA	Defense Advanced Research Projects Agency.
DAS	Data Acquisition System.
DBHS	Data Base Handling System.
DCA	Defense Communications Agency.
DCAA	Defense Contract Audit Agency.
DCAS	Defense Contract Administration Services.
DCASR	DCAS Region.
DCC	Digital Control Computer.
DCP	Development Concept Paper (DoD).
DCS	Defense Communications System.

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DCTN	Defense Commercial Telecommunications Network.
DDA	Dynamic Demand Assessment (Delta Modulation).
DDC	Defense Documentation Center.
DDL	Digital Data Link - A segment of a communications network used for data transmission in digital form.
DDN	Defense Data Network.
DDS	Dynamic Diagnostics System.
D&F	Determination and Findings - required documentation for approval of a negotiated procurement.
DIA	Defense Intelligence Agency.
DIF	Document Interchange Format, Navy-sponsored word processing standard.
DHHS	Department of Health and Human Services
DIDS	Defense Integrated Data Systems.
DISC	Defense Industrial Supply Center.
DLA	Defense Logistics Agency.
DMA	Defense Mapping Agency.
DNA	Defense Nuclear Agency.
DO	Delivery Order.
DOA	Department of Agriculture (also USDA).
DOC	Department of Commerce.
DOE	Department of Energy.
DOI	Department of Interior.
DOJ	Department of Justice.
DOS	Department of State.
DOT	Department of Transportation.
DPA	Delegation of Procurement Authority (granted by GSA under FPRs).
DPC	Defense Procurement Circular.
DQ	Definite Quantity Contract.
DQ/PL	Definite Quantity Price List Contract.
DR	Deficiency Report
DSN	Defense Switched Network
DSP	Defense Support Program (WWMCCS).
DSS	Defense Supply Service.
DTC	Design-To-Cost.
ECP	Engineering Change Proposal.
ED	Department of Education.
EEO	Equal Employment Opportunity.
8(a) Set-Aside	Agency awards direct to Small Business Administration for direct placement with a socially/economically disadvantaged company.
EMC	Electro-Magnetic Compatibility.
EMCS	Energy Monitoring and Control System.
EO	Executive Order - Order issued by the President.
EOQ	Economic Ordering Quantity.
EPA	Economic Price Adjustment.
EPA	Environmental Protection Agency.

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EPMR	Estimated Peak Monthly Requirement.
EPS	Emergency Procurement Service (GSA) or Emergency Power System.
EUC	End User Computing, especially in DoD.
FA	Formal Advertising.
FAC	Facility Contract.
FAR	Federal Acquisition Regulations.
FCA	Functional Configuration Audit.
FCC	Federal Communications Commission.
FCDC	Federal Contract Data Center.
FCRC	Federal Contract Research Center.
FDPC	Federal Data Processing Center.
FEDSIM	Federal (Computer) Simulation Center (GSA).
FEMA	Federal Emergency Management Agency.
FFP	Firm Fixed-Price Contract (also Lump Sum Contract).
FIPS	NBS Federal Information Processing Standard.
FIPS PUBS	FIPS Publications.
FIRMR	Federal Information Resource Management Regulations.
FMS	Foreign Military Sales.
FOC	Final Operating Capability.
FOIA	Freedom of Information Act.
FP	Fixed-Price Contract.
FP-L/H	Fixed-Price - Labor/Hour Contract.
FP-LOE	Fixed-Price - Level-Of-Effort Contract.
FPMR	Federal Property Management Regulations.
FPR	Federal Procurement Regulations.
FSC	Federal Supply Classification.
FSG	Federal Supply Group.
FSN	Federal Supply Number.
FSS	Federal Supply Schedule or Federal Supply Service (GSA).
FSTS	Federal Secure Telecommunications System.
FT Fund	A revolving fund, designated as the Federal Telecommunications Fund, used by GSA to pay for GSA-provided common-user services, specifically including the current FTS and proposed FTS 2000 services.
FTPS NCS;	Federal Telecommunications Standards Program administered by Standards are published by GSA.
FTS	Federal Telecommunications System.
FTS 2000	Proposed replacement for the Federal Telecommunications System.
FY	Fiscal Year.
FYDP	Five-Year Defense Plan.
GAO	General Accounting Office.
GFE	Government-Furnished Equipment.
GFM	Government-Furnished Material.
GFY	Government Fiscal Year (October to September).

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GIDEP	Government-Industry Data Exchange Program.
GOCO	Government Owned - Contractor Operated.
GOGO	Government Owned - Government Operated.
GPO	Government Printing Office.
GPS	Global Positioning System.
GS	General Schedule.
GSA	General Services Administration.
HPA	Head of Procuring Activity.
HSDP	High-Speed Data Processors.
HUD	(Department of) Housing and Urban Development.
ICA	Independent Cost Analysis.
ICAM	Integrated Computer-Aided Manufacturing.
ICE	Independent Cost Estimate.
ICP	Inventory Control Point.
ICST	Institute for Computer Sciences and Technology, National Bureau of Standards, Department of Commerce.
IDAMS	Image Display And Manipulation System.
IDEP	Interservice Data Exchange Program.
IDN	Integrated Data Network.
IFB	Invitation For Bids.
IOC	Initial Operating Capability.
IOI	Internal Operating Instructions.
IQ	Indefinite Quantity Contract.
IR&D	Independent Research & Development.
IRM	Information Resource Manager.
IXS	Information Exchange System.
JOCIT	Jovial Compiler Implementation Tool.
JSIPS	Joint Systems Integration Planning Staff.
JSOP	Joint Strategic Objectives Plan.
JSOR	Joint Service Operational Requirement.
JUMPS	Joint Uniform Military Pay System.
LC	Letter Contract.
LCC	Life Cycle Costing.
LCMP	Life Cycle Management Procedures (DD7920.1).
LCMS	Life Cycle Management System.
L-H	Labor-Hour Contract.
LOI	Letter of Interest.
LRPE	Long-Range Procurement Estimate.
MAISRC	Major Automated Information Systems Review Council (DoD).
MANTECH	MANufacturing TECHnology.
MAPS	Multiple Address Processing System.
MASC	Multiple Award Schedule Contract.
MDA	Multiplexed Data Accumulator.

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MENS	Mission Element Need Statement or Mission Essential Need Statement (see DD-5000.1 Major Systems Acquisition).
MILSCAP	Military Standard Contract Administration Procedures.
MIL SPEC	Military Specification.
MIL STD	Military Standard.
MIPR	Military Interdepartmental Purchase Request.
MOD	Modification.
MOL	Maximum Ordering Limit (Federal Supply Service).
MPC	Military Procurement Code.
MYP	Multi-Year Procurement.
NARDIC	Navy Research and Development Information Center.
NASA	National Aeronautics and Space Administration.
NBS	National Bureau of Standards.
NCMA	National Contract Management Association.
NCS	National Communications System; responsible for setting U.S. Government standards administered by GSA; also holds primary responsibility for emergency communications planning.
NICRAD	Navy-Industry Cooperative Research and Development.
NIP	Notice of Intent to Purchase.
NMCS	National Military Command System.
NSA	National Security Agency.
NSEP	National Security and Emergency Preparedness.
NSF	National Science Foundation.
NSIA	National Security Industrial Association.
NTIA	National Telecommunications and Information Administration of the Department of Commerce; replaced the Office of Telecommunications Policy in 1970 as planner and coordinator for government communications programs; primarily responsible for radio.
NTIS	National Technical Information Service.
Obligation	"Earmarking" of specific funding for a contract from committed agency funds.
OCS	Office of Contract Settlement.
OFCC	Office of Federal Contract Compliance.
Off-Site	Services to be provided near but not i government facilities.
OFMP	Office of Federal Management Policy (GSA).
OFPP	Office of Federal Procurement Policy.
OIRM	Office of Information Resources Management.
O&M	Operations & Maintenance.
OMB	Office of Management and Budget.
O,M&R	Operations, Maintenance, and Repair.
On-Site	Services to be performed on a government installation or in a specified building.
OPM	Office of Procurement Management (GSA) or Office of Personnel Management.
Options	Sole-source additions to the base contract for services or goods to be exercised at the government's discretion.

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OSHA	Occupational Safety and Health Act.
OSP	Offshore Procurement.
OTA	Office of Technology Assessment (Congress).
Out-Year	Proposed funding for fiscal years beyond the Budget Year (next fiscal).
P-I	FY Defense Production Budget.
P3I	Pre-Planned Product Improvement (program in DoD).
PAR	Procurement Authorization Request or Procurement Action Report.
PAS	Pre-Award Survey.
PASS	Procurement Automated Source System.
PCO	Procurement Contracting Officer.
PDA	Principal Development Agency.
PDM	Program Decision Memorandum.
PDR	Preliminary Design Review.
PIR	Procurement Information Reporting.
PME	Performance Monitoring Equipment.
PMP	Purchase Management Plan.
PO	Purchase Order or Program Office.
POM	Program Objective Memorandum.
PPBS	Planning, Programming, Budgeting System.
PR	Purchase Request or Procurement Requisition.
PS	Performance Specification - alternative to a Statement of Work, when work to be performed can be clearly specified.
QA	Quality Assurance.
QAO	Quality Assurance Office.
QMCS	Quality Monitoring and Control System (DoD software).
QMR	Qualitative Material Requirement (Army).
QPL	Qualified Products List.
QRC	Quick Reaction Capability.
QRI	Quick Reaction Inquiry.
R-I	FY Defense RDT&E Budget.
RAM	Reliability, Availability, and Maintainability.
RC	Requirements Contract.
R&D	Research and Development.
RDA	Research, Development, and Acquisition.
RDD	Required Delivery Date.
RD&E	Research, Development, and Engineering.
RDF	Rapid Deployment Force.
RDT&E	Research, Development, Test, and Engineering.
RFI	Request For Information.
RFP	Request For Proposal.
RFQ	Request For Quotation.
RFTP	Request For Technical Proposals (Two-Step).
ROC	Required Operational Capability.
ROI	Return On Investment.

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RTAS	Real Time Analysis System.
RTDS	Real Time Display System.
SA	Supplemental Agreement.
SBA	Small Business Administration.
SB Set-Aside	Small Business Set-Aside contract opportunities with bidders limited to certified small businesses.
SCA	Service Contract Act (1964 as amended).
SCN	Specification Change Notice.
SDN	Secure Data Network.
SEC	Securities and Exchange Commission.
SE&I	Systems Engineering and Integration.
SETA	Systems Engineering/Technical Assistance.
SETS	Systems Engineering/Technical Support.
SIBAC	Simplified Intragovernmental Billing and Collection System.
SIMP	Systems Integration Master Plan.
SIOP	Single Integrated Operations Plan.
SNAP	Shipboard Nontactical ADP Program.
Sole Source	Contract award without competition.
Solicitation	Invitation to submit a bid.
SOR	Specific Operational Requirement.
SOW	Statement of Work.
SSA	Source Selection Authority (DoD).
SSAC	Source Selection Advisory Council.
SSEB	Source Selection Evaluation Board.
SSO	Source Selection Official (NASA).
STINFO	Scientific and Technical INFOrmation Program - Air Force/NASA.
STU	Secure Telephone Unit.
SWO	Stop-Work Order.
Synopsis before	Brief Description of contract opportunity in CBD after D&F and release of solicitation.
TA/AS	Technical Assistance/Analysis Services.
TEMPEST	Studies, inspections, and tests of unintentional electromagnetic radia tion from computer, communication, command, and control equipment that may cause unauthorized disclosure of information; usually applied to DoD and security agency testing programs.
TILO	Technical and Industrial Liason Office—Qualified Requirement Information Program - Army.
TM	Time and Materials contract.
TOA	Total Obligational Authority (Defense).
TOD	Technical Objective Document.
TR	Temporary Regulation (added to FPR, FAR).
TRACE	Total Risk Assessing Cost Estimate.
TRCO	Technical Representative of the Contracting Offices.
TREAS	Department of Treasury.
TRP	Technical Resources Plan.
TSP	GSA's Teleprocessing Services Program.

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TVA	Tennessee Valley Authority.
UCAS	Uniform Cost Accounting System.
USA	U.S. Army.
USAF	U.S. Air Force.
USCG	U.S. Coast Guard.
USMC	U.S. Marine Corps.
USN	U.S. Navy.
U.S.C.	United States Code.
USPS	United States Postal Service.
USRRB	United States Railroad Retirement Board.
VA	Veterans Administration.
VE	Value Engineering.
VHSIC	Very High Speed Integrated Circuits.
VIABLE	Vertical Installation Automation BaseLine (Army).
VICI	Voice Input Code Identifier.
WBS	Work Breakdown Structure.
WGM	Weighted Guidelines Method.
WIN	WWMCCS Intercomputer Network.
WIS	WWMCCS Information Systems.
WS	Work Statement - Offerer's description of the work to be done (pro-
posal	or contract).
WWMCCS	World-Wide Military Command and Control; System.

B
General and Industry

ADP	Automatic Data Processing.
ADPE	Automatic Data Processing Equipment.
ANSI	American National Standards Institute.
CAD	Computer-Aided Design.
CAM	Computer-Aided Manufacturing.
CBEMA	Computer and Business Equipment Manufacturers Association.
CCITT	Comite Consultaif Internationale de Telegraphique et Telephonique; Committee of the International Telecommunication Union.
COBOL	COmmon Business-Oriented Language.
CPU	Central Processor Unit.
DMBS	Data Base Management System.
EIA	Electronic Industries Association.
IEEE	Institute of Electrical and Electronics Engineers.

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ISO	International Organization for Standardization; voluntary international standards organization and member of CCITT.
ITU	International Telecommunication Union.
LSI	Large-Scale Integration.
PROM	Programmable Read-Only Memory.
UPS	Uninterruptable Power Source.
VLSI	Very Large Scale Integration.

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Appendix: Policies, Regulations, and Standards

A

OMB Circulars

A-11	Preparation and Submission of Budget Estimates.
A-49	Use of Management and Operating Contracts.
A-71	Responsibilities for the Administration and Management of Automatic Data Processing Activities.
A-76	Policies for Acquiring Commercial or Industrial Products and Services Needed by the Government.
A-109	Major Systems Acquisitions.
A-120	Guidelines for the Use of Consulting Services.
A-121	Cost Accounting, Cost Recovery, and Integrated Sharing of Data Processing Facilities.
A-123	Internal Control Systems.
A-127	Financial Management Systems.
A-130	Management of Federal Information Resources.

B

GSA Publications

The FIRMR as published by GSA is the primary regulation for use by federal agencies in the management, acquisition, and use of both ADP and telecommunications information resources.

C

DoD Directives

DD-5000.1	Major System Acquisitions.
DD-5000.2	Major System Acquisition Process.
DD-5000.11	DoD Data Elements and Data Codes Standardization Program.
DD-5000.31	Policy and Procedures for the Management and Control of High-Order Languages and Mandate for Use of Ada Language for all DoD Mission-Critical Applications.

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DD-5000.35	Defense Acquisition Regulatory Systems.
DD-5200.1	DoD Information Security Program.
DD-5200.28	Security Requirements for Automatic Data Processing (ADP) Systems.
DD-5200.28-M	Manual of Techniques and Procedures for Implementing, Deactivating, Testing, and Evaluating Secure Resource Sharing ADP Systems.
DD-7920.1	Life Cycle Management of Automated Information Systems (AIS).
DD-7920.2	Major Automated Information Systems Approval Process.
DD-7935	Automated Data Systems (ADS) Documentation.

D

DoD Regulations

AFR 800-14	Air Force Regulation, Life Cycle Management of Computer Resources.

E

Standards

ADCCP	Advanced Data Communications Control Procedures; ANSI Standard X3.66 of 1979; also NBS FIPS 71.
CCITT G.711	International PCM Standard.
CCITT T.0	International Standard for Classification of Facsimile Apparatus for Document Transmission Over Telephone-Type Circuits.
DEA-1	Proposed ISO Standard for Data Encryption Based on the NBS DES.
EIA RS-170	Monochrome Video Standard.
EIA RS-170A	Color Video Standard.
EIA RS-464	EIA PBX Standards.
EIA RS-465	Standard for Group III Facsimile.
EIA RS-466	Facsimile Standard; Procedures for Document Transmission in the General Switched Telephone Network.
EIA RS-232-C	EIA DCE to DTE Interface Standard Using a 25-Pin Connector; Similar to CCITT V-24.
EIA RS-449	New EIA Standard DTE to DCE Interface which Replaces RS-232-C.
FED-STD 1000	Proposed Federal Standard for Adoption of the Full OSI Reference Model.
FED-STD 1026	Federal Data Encryption Standard (DES) Adopted in 1983; also FIPS 46.
FED-STD 1041	Equivalent to FIPS 100.
FED-STD 1061	Group II Facsimile Standard (1981).

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FED-STD 1062	Federal Standard for Group III Facsimile; Equivalent to EIA RS-465.
FED-STD 1063	Federal Facsimile Standard; Equivalent to EIA RS-466.
FED- STDs 1005, 1005A-1008	Federal Standards for DCE Coding and Modulation.
FIPS 46	NBS Data Encryption Standard (DES).
FIPS 81	DES Modes of Operation.
FIPS 100	NBS Standard for Packet-Switched Networks; Subset of 1980 CCITT X.25.
FIPS 107	NBS Standard for Local Area Networks, Similar to IEEE 802.2 and 802.3.
IEEE 802.2	OSI-Compatible IEEE Standard for Data-Link Control in Local Area Networks.
IEEE 802.3	Local Area Network Standard Similar to Ethernet.
IEEE 802.4	OSI-Compatible Standard for Token-Bus Local Area Networks.
IEEE 802.5	Local Area Networks Standard for Token-Ring Networks.
MIL-STD-188-114C	Physical interface protocol similar to RS-232 and RS-449.
MIL-STD-1750A	Embedded system microchip architecture specification.
MIL-STD-1777	IP-Internet Protocol.
MIL-STD-1778	TCP - Transmission Control Protocol.
MIL-STD-1780	File Transfer Protocol.
MIL-STD-1781	Simple Mail Transfer Protocol (Electronic Mail).
MIL-STD-1782	TELNET - Virtual Terminal Protocol.
MIL-STD-1815A	Standard for the Ada Programming Language, February 1983.
MIL-STD 2167	Defense System Software Development.
X.21	CCITT Standard for Interface between DTE and DCE for Synchronous Operation on Public Data Networks.
X.25	CCITT Standard for Interface between DTE and DCE for Terminals Operating in the Packet Mode on Public Data Networks.
X.75	CCITT Standard for Links that Interface Different Packet Networks.
X.400	ISO Application-Level Standard for the Electronic Transfer of Messages (Electronic Mail).

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Appendix: Related INPUT Reports

A

Annual Market Analyses

Procurement Analysis Reports, GFY 1987-1992.

U.S. Professional Services Market, 1986-1991.

U.S. Information Services Cross-Industry Markets, 1986-1991.

U.S. Information Services Industry, 1986.

U.S. Information Services Vertical Markets, 1986-1991.

Customer Service in Europe, 1986.

B

Industry Surveys

Directory of Leading U.S. Information Services Vendors, 1986.

Information Services Industry Report, 1986.

Eighteenth Annual ADAPSO Survey of the Computer Services Industry, 1984.

C

Market Reports

Analysis of Software Service and Support, 1986.

EDI Software Providers Profile, 1987.

Federal Office Information Systems Market, 1986-1991.

Federal Systems Integration Market, 1987-1992.

IBM Operating Systems Strategies, 1986.

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Federal ADP Facilities Management Market, 1987-1992

Federal Communications Market, 1987-1991

Federal Government Professional Services Market, 1986-1991.

Applications Software Development Tools, 1986

Trends in Microcomputer Operating Systems, 1985.

D

Software Planning Reports

Software Productivity, 1986.

Departmental Systems and Software Directions, 1986.

IBM Operating Systems Strategies, 1986.

Analysis of Prototyping, 1986.

Decision Support Systems: Experience and Knowledge, 1986.

Decision Support System Development—Major European Markets, 1986.

Major Western European Markets for Information Services—Analysis and Forecasts, 1986.

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Appendix: Questionnaires

Software and Related Services

INPUT/Vendor Questionnaire
Study Title: *Federal Software Market, 1987-1992*

Catalog No. FISS-411

Study Code: G-SR2
Date:

Federal Software Market - Vendor Questionnaire

1. Which of the following software products or custom professional services have you provided (past) or plan to provide (future) to the federal government over the next 2 to 5 years?

	Past	Future		
	Yes	No	Yes	No	Why?
Applications Software Packages					
Systems Software Packages					
Custom Appli. Software Dev.					
Contract Software Maint.					

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2. What was your total revenue for software packages, custom software development, and/or contract software maintenance last year? $ _____

3. About what percent of your federal software and services revenues were generated in each of the following areas?

	Percent
Applications Software Packages	_____
Operation Systems Software Packages	_____
Custom Applications Software Development	_____
Custom Systems Software Development	_____
Contract Software Maintenance	_____

4. Would you categorize your organization as a:

_____ Software House
_____ Systems House
_____ Service Organization
_____ Other (specify) _____

5. For what types of applications, languages, and size of hardware (mainframe, mini, micro) do you provide software products, software development, and/or support services?

Applications	Languages(s)	Hardware

6. In which of the following categories of software and services do you expect either an increase or decrease in the next 2 to 5 years and by what percent change, in your opinion?

	Increase	Decrease	Percent Change
Applications Packages			
Systems Packages			

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Custom Applications Software
Development

Custom Systems Software
Development

Contract Software Maintenance

7. Are you now, or do you plan to become qualified in Ada programming?

_____ Now _____ Plan to _____ No

(If Now or Plan to)

Do you have access to one or more certified Ada Compilers?

Yes _____ No _____

8. Does your company offer any software products or software services to support supercomputers?

Yes _____ No _____

List supercomputers products and services: _____
_____

9. For the Systems Integration and Turnkey Systems that your company provides, (if any), what portion (%) of these projects would you estimate is allocated for software and software related service? _____%

10. Based on your experience with the acquisition methods used by federal agencies for buying software, could you estimate a percentage for each type of software purchase?

a. Purchase or Lease Commercial Software

1. Lease of Software Packages _____%
2. GSA Schedule (including Computer Store) _____%
3. Competitive Bid _____%
4. Purchase Order _____%
5. Other (specify) _____%

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b. Purchase of custom professional services:

1. GSA Contractor Support Program _____%
2. Competitive Bid _____%
3. Purchase Order _____%
4. Other (specify) _____%

11a. In your opinion, what do you estimate to be the percentage split between operating systems software and applications software being purchased by the federal government?

_____% Operating System _____% Application

11b. What types of operating systems software are being procured?

11c. Are you aware of any special requirements for operating systems software by agencies? Examples: (AI/Expert Systems, DBMS)

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12. Does your company provide any agencies with communications software packages?

Micro-Mainframe _____
Intra-Network _____
Inter-Network _____

13. Does your company provide any Software Productivity Generators?

If yes, what are they?

What has been the sales record in this area?

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14. What has been your activities on Software Development Packages?

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15. Have standards activities (from NBS, the oversights or such organizations as the ISO) had any impact on your providing software to the federal market?

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16. In your opinion, what has been the impact of federal budgetary constraints on the software marketplace?

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About INPUT

Company Profile

Founded in 1974, INPUT has become a leading international planning services firm. Clients include over 200 of the world's largest and most technically advanced companies.

Through market research, technology forecasting, and market/competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, office systems, and information services. Clients receive reports, presentations, access to data on which analyses are based, and continuous client support.

INPUT is a service company. Through advisory/research planning services, multiclient studies, and proprietary consulting, INPUT serves clients' ongoing planning information needs.

Staff Credentials

INPUT's professional staff have backgrounds in marketing, planning, information processing, and market research in some of the world's leading organizations. Many of INPUT's professional staff have held executive positions in the following business sectors:

- Computer systems
- Software
- Turnkey systems
- Field service (customer service)
- Processing services
- Professional services
- Data processing
- Network services
- Communications

Educational backgrounds include both technical and business specializations, and many INPUT staff hold advanced degrees.

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Domestic and European Planning Services

INPUT offers eight basic information services: six covering U.S. information industry markets and two covering European information industry markets.

1. Market Analysis Service (MAS)

Provides up-to-date U.S. information services market analyses, five-year forecasts, trend analyses and sound recommendations for action. MAPS is designed to satisfy the planning and marketing requirements of current and potential information services vendors.

2. Company Analysis Service (CAS)

Is a comprehensive reference service covering more than 4,000 U.S. information services vendor organizations. CAS is often used for competitive analysis and pre-screening of acquisition and joint venture candidates.

3. Electronic Data Interchange Planning Service (EDIPS)

Focusing on what is fast becoming a major computer/communications market opportunity, INPUT's EDIPS keeps you informed. Through monthly newsletters, timely news flashes, comprehensive studies, joint user/vendor conference, and telephone inquiry privileges you will be informed and stay informed about the events and issues impacting this burgeoning market.

4. Federal Information Systems and Services Program (FISSP)

Presents highly specific information on U.S. federal government procurement practices, identifies information services vendor opportunities, and provides guidance from INPUT's experienced Washington professionals to help clients maximize sales effectiveness in the government marketplace.

5. Information Systems Program (ISP)

Is designed for executives of small, medium, and large information systems organizations and provides crucial information for planning, procurement, and management decision making. The program examines new service offerings, technological advances, user requirements for systems and services, IS spending patterns, and more. ISP is widely used by both user and vendor organizations.

6. Customer Service Program U.S. (CSP)

Provides customer service organization management with data and analyses needed for marketing, technical, financial, and organizational planning.

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The program pinpoints user perceptions of service received, presents vendor-by-vendor service comparisons and analyzes and forecasts service markets for large systems, small systems, telecommunications systems, software maintenance, and third-party maintenance.

7. Western European Customer Service Program (CSPE)

Parallels the U.S. Customer Service Program, dealing with comparable issues in European markets.

8. Western European Information Services Program (ISPE)

Analyzes and forecasts European information services markets. Clients receive timely planning information through research-based studies, conferences, client meetings, and continuous client support.

Customized Planning Services Available

In addition to standard continuous information programs, INPUT will work with you to develop and provide a customized planning service which meets your unique requirements.

An Effective Combination

INPUT'S Executive Planning Services are built upon an effective combination of research-based studies, client meetings, informative conferences, and continuous client support. Each service is designed to deliver the information you need in the form most useful to you, the client. Executive Planning Services are composed of *varied combinations of the following* products and services:

Research-Based Studies

Following a proven research methodology, INPUT conducts major research studies throughout each program year. 1987 projects include:

- √ Commercial Systems Integration Implementations
- √ On-Line Data Base Markets, 1987-1992
- √ Network Integration
- √ Future DBMS Markets
- √ Economics of Distributed Data Processing
- √ Guide to EDI Implementation
- √ Chargeback Systems for IS Organizations
- √ Office Productivity
- √ Distributed Data Base Management
- √ DEC vs. IBM 1987-1992
- √ Third-Party Maintenance User Requirements & Market Analysis
- √ Large- and Small-Systems Service Market Analysis
- √ Customer Service Pricing
- √ Automated Field Service Delivery

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√ Software Maintenance Markets
√ Third-Party Maintenance Competitive Analysis
...and more!

Information Service Industry Reports
INPUT's Executive Planning Services address specific issues, competitive environment and user expenditures relative to:

Software	Professional Services
Processing/Network Services	Turnkey Systems
Systems Integration	Small-Systems Service
Telecommunications Service	Third-Party Maintenance
Office Systems	Large-Systems Service

Industry Market Reports
Detailed analysis of market trends, forces driving the markets, problems, opportunities and user expenditures are available for the following segments:

Banking/Finance	Accounting
Discrete Manufacturing	Education/Training
Distribution	Engineering/Scientific
Education	Human Resources
Federal/State and Local Government	Planning and Analysis
Insurance	Systems Software
Medical	Utility Processing
Process Manufacturing	Value-Added Networks
Service Industry	Other Cross-Industry Markets
Telecommunications	Transportation
Utilities	

Hotline: Client Inquiry Services
Daily, weekly, monthly, quarterly, and annual client planning questions are answered quickly and completely through use of INPUT's Client Hotline. Clients may call any INPUT office (California, New Jersey, Washington D.C., or London) during business hours or they may call a unique voicemail service to place questions after hours. This effective Hotline service is the cornerstone of every INPUT Executive Planning Service.

The Information Center
One of the largest and most complete collections of information services industry data, the Information Center houses literally thousands of up-to-date files on vendors, industry markets, applications, current/emerging technologies, and more. Clients have complete access to the Information Center. In addition to the information contained in its files, the center

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maintains an 18-month inventory of over 130 major trade publications, vendor consultant manuals, economic data, government publications, and a variety of important industry documents.

Access to INPUT Professional Staff
Direct access to our staff, many of whom have more than 20 years of experience in the information industry, provides you continuous research and planning support. When you buy INPUT, you buy experience and knowledge.

Annual Client Conference
Each year, you can attend INPUT's Annual Client Conference. This three-day event addresses the status and future of the information services industry, the competitive environment, important industry trends potentially affecting your business, the impact of new technology and new service offerings, and more.

You will attend with top executives from many of the industry's leading, fastest-growing, and most successful vendor companies, and with top Information Systems (IS) managers from some of the world's most sophisticated user organizations.

On-Site Presentation by INPUT Executive
Many of INPUT's Planning Services offer an informative presentation at your site. Covering the year's research, this session is held in the fourth quarter of each calendar year.

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INPUT conducts proprietary research that meets the unique requirements of an individual client. INPUT's custom research is effectively used:

For Business Planning
Planning for new products, planning for business startups, planning expansion of an existing business or product line—each plan requires reliable information and analysis to support major decisions. INPUT's dedicated efforts and custom research expertise in business planning ensure comprehensive identification and analysis of the many factors affecting the final decision.

For Acquisition Planning
Successful acquisition and divestiture of information services companies requires reliable information. Through constant contact with information services vendor organizations, continuous tracking of company size, growth, financials, and management "chemistry," INPUT can provide the valuable insight and analysis you need to select the most suitable candidates.

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For The Total Acquisition Process
INPUT has the credentials, the database of company information and, most importantly, the contacts to assist you with the total acquisition and/or partnering relationship processes:

√ Due Diligence
√ Schedules and Introduction
√ Establish Set of Criteria & Definitions
√ Retainer and Fee-Based
√ Active Search

For Competitive Analysis
Knowing marketing and sales tactics, product capabilities, strategic objectives, competitive posture, and strengths and weaknesses of your competition is as critical as knowing your own. The career experience of its professionals, coupled with its collection and maintenance of current financial, strategic, tactical and operational information about more than 4,000 active companies, uniquely qualifies INPUT to provide the best competitive information available today.

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Developing new products and entering new markets involves considerable investment and risk. INPUT regularly conducts research for clients to identify product requirements, market dynamics, and market growth.

More About INPUT...
- More than 5,000 organizations, worldwide, have charted business direction based on INPUT's research and analysis.
- Many clients invest more than $50,000 each year to receive INPUT's recommendations and planning information.
- INPUT conducts proprietary research, regularly, for some of the largest companies in the world.
- INPUT has developed and maintains one of the most complete information industry libraries in the world (access is granted to all INPUT clients).
- INPUT clients control an estimated 70% of the total information industry market.
- INPUT analyses and forecasts are founded upon years of practical experience, knowledge of historical industry performance, continual tracking of day-to-day industry events, knowledge of user and vendor plans, and business savvy.

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- INPUT analysts accurately predicted the growth of the information services market—at a time when most research organizations deemed it a transient market. INPUT predicted the growth of the microcomputer market in 1980 and accurately forecasted its slowdown in 1984.

For More Information . . .

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